West Winch Housing Access Road

Environmental Statement Chapter 1: Appendix 1: EIA Scoping Report

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Contents

Tables

Figures

1 Introduction

1.1 Purpose of the report

1.1.1 This Environmental Impact Assessment (EIA) Scoping Report for the proposed West Winch Housing Access Road (WWHAR), referred to within this report as 'the scheme', has been produced by WSP on behalf of Norfolk County Council (NCC) who are working in partnership with the Borough Council of Kings Lynn and West Norfolk (BCKLWN).

1.1.2 The scheme would allow for access and egress to the proposed housing developments within land immediately to the east of West Winch village. This land has been designated under the BCKLWN Local Plan (King's Lynn & West Norfolk Borough Council, Site Allocations and Development Management Policies Plan, Adopted September 2016.) for up to 4,000 dwellings. The scheme will also provide a link between the A47, to the north, and A10, to the south.

1.1.3 It is considered that the scheme falls under Schedule 2.10 Infrastructure projects, paragraph (f) (The Town and Country Planning (Environmental Impact Assessment) Regulations 2017) construction of roads of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017/571), (hereafter referred to as the 'EIA Regulations'). For Schedule 2 Development, an EIA is required only if the project is judged likely to give rise to significant environmental effects by virtue of factors such as a size, nature and location of the proposal (as detailed in Schedule 3 of the EIA Regulations 2017).

1.1.4 The scheme is considered to be an 'EIA development' as confirmed by NCC as Planning Authority in their scoping opinion (dated 15th November 2019) provided in response to WSP's Combined Screening and Scoping Report formally submitted on 19th June 2019.

1.1.5 The purpose of this EIA Scoping Report is to seek an updated scoping opinion from NCC Planning Authority following updates to the scheme, in

particular the inclusion of several pipeline diversions. This report aims to establish the scope of the Environmental Statement (ES) for the scheme by reviewing existing data and identifying sensitive resources and receptors. It then proceeds in determining the appropriate level of effort that should be applied to the various environmental topics, namely whether a Simple or Detailed assessment as defined in Design Manual for Roads and Bridges (DMRB) Sustainability and Environmental Appraisal LA 103 Scoping projects for environmental assessment (LA 103 - Scoping projects for environmental assessment).

1.1.6 Following the receipt of the updated scoping opinion from NCC Planning Authority, the statutory EIA process will continue in accordance with the EIA Regulations 2017 and will be documented within an Environmental Statement (ES). The ES will be submitted for consideration and approval along with an application for planning permission under the Town and Country Planning Act 1990 (as amended). The ES will record all significant beneficial and adverse, direct, indirect and cumulative environmental effects of the scheme including effective and sustainable mitigation measures and identification of residual effects.

1.1.7 As per the requirements of Regulation 15 (2) of the EIA Regulations 2017, the following information has been provided as part of this EIA Scoping Report as detailed in Table 1.1.

Table 1.1 – Information required by regulation 15 (2) of the EIA regulations 2017

Information Required	Location within the EIA Scoping Report
A plan sufficient to identify the land	Figure 1-1 and Appendix A
A brief description of the nature and purpose of the development, including its location and technical capacity	Chapter 2 and Appendices A and B

Information Required	Location within the EIA Scoping Report
An explanation of the likely significant effects of the development on the environment	Chapter 3 to Chapter 14
Other information or representations the applicant may wish to provide	Appendix D

1.1.8 Table 1.2 outlines where the environmental factors listed under the EIA Regulations 2017 (Regulation 4 (2)) are considered within this EIA and Scoping Report.

Table 1.2 – Environmental factors under the EIA regulations 2017 and their location within the EIA scoping report

Environmental Factor	Location within EIA Scoping Report
Land and Soil	Chapter 9 – Geology and Soils
Population and Human Health	Chapter 12 – Population and Health, Chapter 7 – Noise and Vibration
Water	Chapter 8 – Water Environment
Biodiversity	Chapter 5 – Biodiversity (including Arboriculture)
Air and Climate	Chapter 3 – Air Quality, Chapter 11 – Climate
Material assets	Chapter 10 – Materials and Waste
Landscape	Chapter 6 – Landscape and Visual
Cumulative	Chapter 13 – Cumulative Assessment
Cultural Heritage	Chapter 4 – Archaeology and Cultural Heritage

1.1.9 In line with the 2014 amendment to the EIA Directive (2014/52), the EIA Regulations 2017 require the consideration of the vulnerability of the development (the scheme in this instance) to risks of major accidents and/or disasters which are relevant to the development concerned. The potential for major events to impact the scheme has been considered within chapter 14 of

this EIA Scoping Report. For all natural and technological (manmade) hazards considered (as documented in Appendix G), based on current design information and on the implementation of mitigation measures presented in technical chapters 3 to 12, the associated risks are anticipated to be as low as reasonably practicable.

1.1.10 The EIA Regulations 2017 also require the consideration of projects with respect to emissions of heat and radiation. Due to the nature of the scheme, neither of these topics are relevant and are therefore screened out from further consideration.

1.1.11 The EIA Scoping Report has been informed by the DMRB (Introduction to the Design Manual for Roads and Bridges (DMRB)). guidance which outlines standards, advice notes and other documents relating to the design, assessment and operation of highways. Other topic specific guidance has been followed as applicable and is referenced within the discipline specific methodologies, set out in technical chapters 3 to 12.

1.2 Other assessments

Habitats regulations assessment

1.2.1 No effects on Natura 2000 sites, including Special Areas for Conservation (SAC) under the European (EU) Habitats Directive and Special Protection Areas (SPA) under the EU Birds Directive, are considered likely as a result of the scheme, therefore a Habitats Regulations Assessment (HRA) is not required. Further information on such sites is included in Chapter 5, Biodiversity.

1.2.2 It should be noted that the EU Habitats Directive and the EU Birds Directive are transposed into UK law through the Conservation of Habitats and Species Regulations 2017 (as amended). The Department for Environment Food and Rural Affairs (DEFRA) published a paper in January 2021 on changes to the Habitats Regulations (2017) due to the UKs exit from the EU. The paper notes that SACs and SPAs in the UK no longer form part of the EU's Natura 2000 ecological network. The 2019 Regulations have created a national site

network on land and at sea, including both the inshore and offshore marine areas in the UK. The national site network includes existing SACs/ SPAs and new SACs/ SPAs designated under these Regulations. Any references to Natura 2000 in the 2017 Regulations and in guidance now refers to the new national site network.

Water framework directive assessment

1.2.3 The desk-based study completed as part of this EIA Scoping Report has confirmed that a detailed Water Framework Directs (WFD) assessment is not required for the scheme. Further information is included in Chapter 8, Water Environment.

Lighting assessment

1.2.4 A lighting assessment and a lighting strategy is to be completed to inform the scheme design. The lighting strategy will be provided as part of the package of planning application documents and will be referenced by the landscape, ecology and climate teams in preparing their assessments.

2 The scheme

2.1 Scheme location

2.1.1 The scheme is located within land to the east of West Winch village, approximately two kilometres (km) south of the centre of Kings Lynn, Norfolk, as shown in Figure 1-1 over page.

2.1.2 The scheme is required to allow for the access to the proposed housing developments east of West Winch which have been identified within the BCKLWN Local Plan as suitable for development for approximately 4,000 new dwellings. A planning application (entitled Land West of Constitution Hill Constitution Hill North Runcton Norfolk PE33 0QP) has been submitted by Hopkins Homes Ltd. for development of the northern extent of this land, also referred to as the Hardwick Green development.

2.1.3 The scheme is located between the A47 (northern extent) and the A10 (southern extent), crossing a number of agricultural land parcels.

2.2 Scheme overview

2.2.1 The proposed scope of works comprising the scheme are further illustrated on the plan included as Appendix A and outlined below:

- 3.5km of new single lane Housing Access Road designed for a 60 miles per hour (60 mph) speed limit;
- A new roundabout junction between the WWHAR and the A47 trunk road providing access to the planned Hardwick Green development;
- A new roundabout junction between the WWHAR and the A10 at the southern end of the WWHAR;
- Intermediate access junctions on the WWHAR to provide access to the residential allocation area;
- Treatment of local roads which will be severed by the WWHAR, including a new road over bridge with shared footway and cycleway on Rectory Lane to cross over the proposed WWHAR and the permanent stopping up of Chequers Lane for vehicular traffic. A new foot/cycle bridge is to be constructed over Chequers Lane to maintain access to pedestrians over WWHAR;
- Modification of the Hardwick Interchange to accommodate additional housing traffic plus a re-orientation of trips through the junction;
- Dualling of the A47 -to the north of the existing highway alignment) between the WWHAR and the A10/A47 Hardwick Interchange junction;
- Temporary working areas for road construction including haul routes. The largest of the compounds will be located to the north at the new roundabout on the A47 with a further compound located to the south west of the new overbridge off Rectory Lane; and

- Two sets of National Grid gas main diversion works including construction compounds and temporary access and working areas.

2.2.2 Figure 2.1 outlines the West Winch Housing allocation site showing the housing access road, dualling of A47, new residential access junction and improvement to Hardwick Interchange.

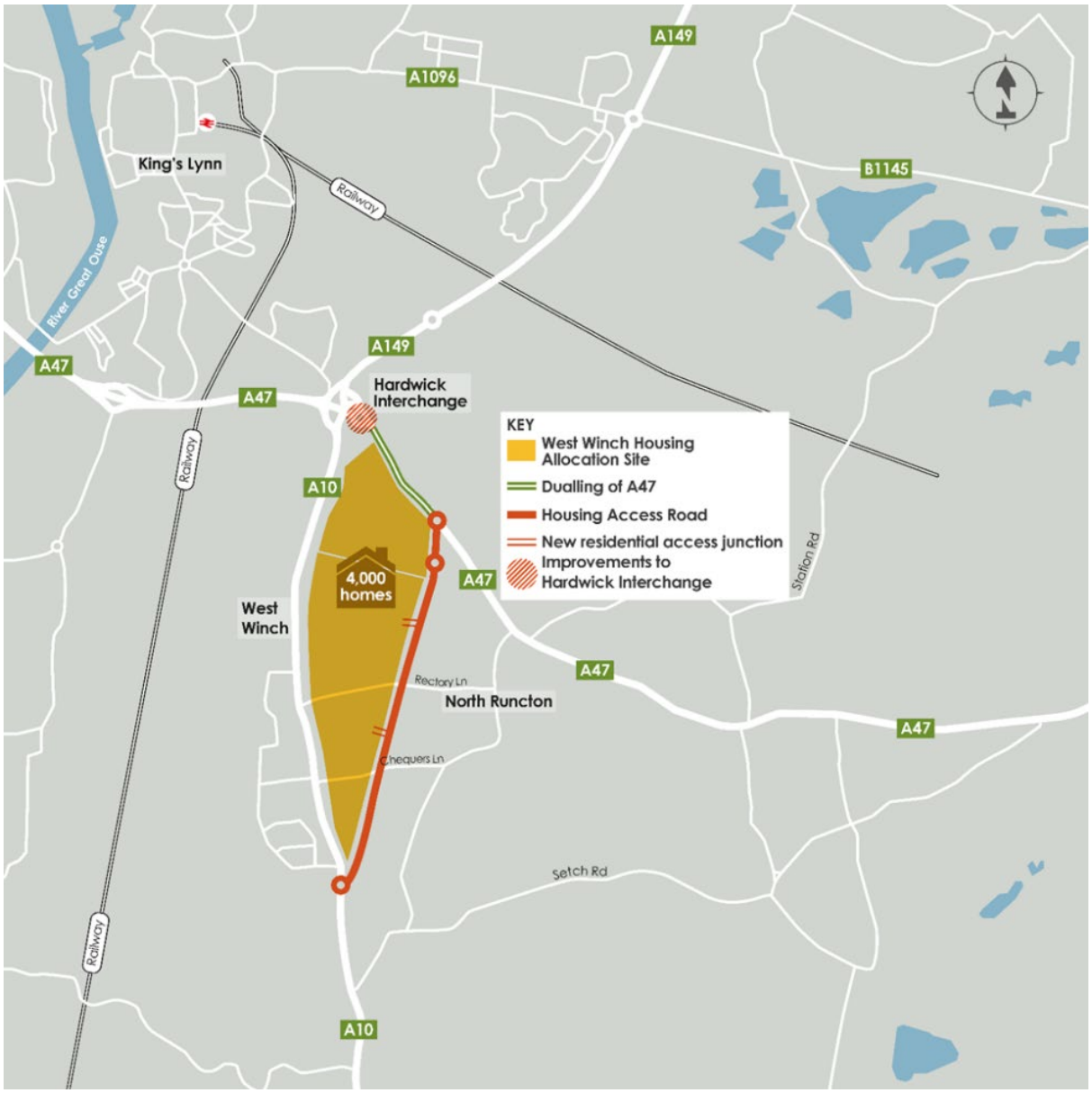

Figure 2.1 – WWHAR Scheme – Map showing the location of the scheme to the east of West Winch village, Norfolk

2.2.3 It should be noted that the scheme boundary as shown in Appendix A is indicative and will be subject to further review once topographic data is

available although no significant changes in the alignment and design are anticipated at this time.

2.2.4 The scheme also proposes the modification of the existing highway network on the existing alignment and the A10 to introduce traffic calming measures. This is required in order to divert the majority of traffic flow away from the A10, once the scheme is constructed, reducing the residual vehicular traffic on the A10. At this stage measures for traffic calming are likely to include:

- New signalised pedestrian crossing;
- Splitter islands;
- Removal of central white lining;
- Visual narrowing of the carriageway;
- Build outs (to create alternating give way movements); and
- A short section of the A10 in the centre of West Winch to be reduced to 20mph to create a 'high street' environment).

2.2.5 The design of these alterations on the A10 is still being developed, however is it considered that the alterations will be minor, within and adjacent to the existing highway alignment. A new roundabout junction is to be created for the connection of the A10 to the WWHAR. The current proposed location of this junction is identified within the scheme plan in Appendix A.

2.2.6 It is anticipated that the dualled section of the A47 as well as the approaches to the Hardwick Interchange and new roundabout junction between the WWHAR and the A47 would be lit. No other scheme lighting is currently proposed.

2.2.7 The scheme requires the diversion of the National Grid Feeders 2 and 4 high pressure gas pipelines, the indicative location of which and diversion works extent are shown in Appendix A. The diversion works are considered to be part of the enabling works associated with the scheme and therefore will be considered within the EIA and form part of the scheme design. Ground

moving activities required as part of the works will include the excavation of a gas pipe trench and the establishment of temporary compound areas and access roads which are shown within scheme boundary in Appendix A. Access to the site establishment area for the Feeder 2 diversion will be via the existing A10 road then turning right onto Chequers Lane. An existing access to the field, in which the site establishment is to be located, will be utilised to allow access from Chequers Lane. Access to the site establishment for the Feeder 4 diversion is proposed to be via an existing field access gate off the A47.

2.2.8 The scheme is not located within any statutory or non-statutory designated sites, however the River Nar Site of Special Scientific Interest (SSSI) is located approximately 700m south of the scheme. The closest designated heritage asset, a listed building, is located within 25m of the scheme corridor. The majority of the scheme falls within Flood Zone 1, with a small proportion of the northern extent within Flood Zone 2. There are no Areas of Outstanding Natural Beauty (AONB), National Parks or Country Parks within 2km of the scheme. There are three Public Rights of Way (PRoW) in close proximity to the scheme. There are seven Noise Important Areas (NIAs) along the existing A10 between the Hardwick Interchange and the proposed tie in with the WWHAR. The nearest Air Quality Management Area (AQMA) is located approximately 1.4km north-west in King's Lynn.

2.2.9 An Environmental Constraints Plan has been produced and included within this report (Appendix B) and further topic-specific baseline information is provided within the relevant environmental sections later within this report.

2.3 Scheme objectives

2.3.1 The primary purpose of the scheme is to facilitate access to sites identified in the BCKLWN Local Plan for housing, including the proposed Hardwick Green development being promoted by Hopkins Homes Ltd. The local highway does not have sufficient highway capacity in its current form to accommodate the anticipated growth, therefore additional capacity must be created.

2.3.2 In addition to providing capacity to facilitate housing, the WWHAR aims to accommodate strategic north-south traffic into and out of King's Lynn, improving reliability for road users, removing heavy good vehicles from residential areas and improving highway safety for residents of West Winch and other vulnerable road users.

2.3.3 The objectives of the WWHAR are outlined below:

- Drive economic growth by supporting housing delivery and employment growth in the region;
- Enhance the A10's role as a strategic link supporting the wider King's Lynn economy;
- Provide a more resilient road network to improve journey time reliability and safety for all users;
- Improve the quality of life of residents of West Winch by reducing the volume of non-local journeys through the village;
- Provide better conditions in West Winch and along the A10 for travel by non-motorised modes; and
- Seek to minimise environmental impacts of intervention.

2.4 Alternatives considered

2.4.1 The South-East King's Lynn Strategic Growth Area has been identified in the BCKLWN Local Plan as the primary site for substantial housing development. This comprises 4,000 new dwellings on land between the A10 and A47. The site has been selected as the only site available in the area for such levels of growth due to flooding constraints elsewhere, and its proximity and links to King's Lynn. King's Lynn is a hub for many neighbouring, smaller rural settlements and offers employment opportunities as well as a range of services in terms of retail, healthcare, social. It is also home to the Port of King's Lynn which can be accessed by road from the A10 and A47 from the

south. The housing development cannot come forward without new highway infrastructure to mitigate the impacts of the additional traffic demand.

2.4.2 The Local Plan dictates that a new route is required to enable the housing, therefore no non-road building/road improvement solutions have been investigated although the WWHAR scheme will incorporate improvements to non-motorised users and facilitate public transport solutions to support the housing growth.

2.4.3 The Local Plan, Site Allocations and Development Management Policies (adopted in 2016) indicated an approximate line for the access road (SADMP Plan Adopted 2016 (page 118 - 119)) which formed the basis of the scheme development and options appraisal work.

2.4.4 Alternative options for the WWHAR have been investigated and a preferred option selected. The options investigated comprised:

- five different alignments at the northern end of the new road between the A10 and A47;
- two different alignments at the southern end of the new road between the A10 and A47; and
- a number of options for junction alterations at the Hardwick A10/A47/A149 junction to suit the rest of the scheme and satisfy Highways England.

3 Air quality

3.1 Study area

3.1.1 For road schemes in England that are not motorway or all-purpose trunk road projects - i.e. not overseen by Highway England, it is usual for highways authorities to adopt aspects of Highways England's Design Manual for Roads and Bridges (DMRB) guidance (Introduction to the Design Manual for Roads and Bridges (DMRB)) where appropriate. DMRB LA 105 'Air Quality' (LA 105 -

Air quality (standardsforhighways.co.uk)) includes guidance to determine the study area. Separate study areas are usually defined for construction and operational phases as discussed below.

Construction

3.1.2 The study area for construction dust impacts will extend up to 200m from the scheme boundary, which encompasses areas subject to construction activities such as earthworks areas and site compounds. Beyond 200m any impact is very unlikely to be perceptible and the effect will not be significant.

3.1.3 The study area for construction traffic impacts will be determined with reference to scoping criteria described below for the operational phase if suitable data are available.

Operation

3.1.4 Once traffic model data for the scheme become available, the following DMRB LA 105 scoping criteria (The DMRB LA 105 changes in speed band criterion given is not included. Speed banding methodology, which a requirement for motorway or all-purpose trunk road projects, will not be applied in the air quality assessment for the scheme. Road links with change in AADT flow less than 1,000 vehicles are very unlikely to experience a substantial change in speed.) will be used to determine whether the air quality impacts can be scoped out or require an assessment based on the changes between the do-something traffic compared to the do-minimum traffic:

- annual average daily traffic (AADT) flow greater than or equal to 1,000 vehicles; or
- heavy duty vehicle (HDV) AADT flow greater than or equal 200 vehicles; or
- a change in carriageway alignment by greater than or equal 5m.

3.1.5 These criteria are normally applied to changes in the opening year although they can also be used where other scenarios need to be considered (such as construction traffic impacts).

3.1.6 The scoping criteria determine what is referred to as the 'affected road network' (ARN), which DMRB LA 105 defines as *"All roads that trigger the traffic screening criteria and adjoining roads within 200m"*. Changes on road links that are not included in the ARN are very unlikely in themselves to result in a significant effect.

3.1.7 If there is an AQMA that is covered by the traffic model simulation network, but where none of the adopted scoping criteria are met, then the need to include the AQMA within the study area will be determined through consultation with the relevant local planning authority.

3.1.8 In line with DMRB LA 105, any local air quality impacts will be limited to within 200m of the ARN. Beyond 200m any impact is very unlikely to be perceptible and the effect will not be significant.

3.2 Consultation

Consultation Undertaken to Date

3.2.1 An initial consultation letter was issued to the Environmental Planning Department at the BCKLWN on the 25th of March 2019 regarding the proposed air quality assessment methodology. On the 29th March 2019, the Scientific Officer at the BCKLWN confirmed that, in general the approach proposed at the time was acceptable.

Proposed Consultation

3.2.2 Further consultation with BCKLWN will be undertaken to confirm the study area and specific details of the assessment methodology, once suitable traffic data become available and have been screened.

3.3 Baseline conditions

Baseline data collected to date

3.3.1 A desk-based review of information in the public domain has been undertaken to determine baseline air quality conditions. The information reviewed comprised:

- Ordnance Survey map data (OS data products | Home | Ordnance Survey);
- BCKLWN air quality information (Air quality | Borough Council of King's Lynn & West Norfolk (west-norfolk.gov.uk)); and
- Air quality data from the Department of Environment, Food and Rural Affairs (Defra) UK Air website (About Air Pollution - Defra, UK).

Overview of baseline air quality

3.3.2 The scheme is in a rural setting immediately to the east of the village of West Winch. The nearest urban area is the town of King's Lynn, to the north. The main transport link connecting West Winch and King's Lynn (and locations to the south) is the A10, which runs along the eastern boundary of the village.

3.3.3 The route corridor of the scheme is not located within an AQMA. The nearest AQMA is approximately 1.4 km to the northwest in King's Lynn along the A148 London Road, including the Railway Road/Blackfriars Road gyratory, known as the Town Centre AQMA. A second AQMA, located approximately within 1km to the east of King's Lynn town centre, includes the junction of the 148 Lynn Road/Wootton Road and A1076 Gayton Road, known as the Gaywood Clock AQMA. Both AQMAs were declared for exceedances of the 40 micrograms per cubic metre ($\mu g/m^3$) air quality objective for annual mean NO_2. The exceedances have been attributed to localised high emissions of oxides of nitrogen (NO_x) from road vehicles.

3.3.4 BCKLWN monitors ambient concentrations of NO_2, coarse particulate matter – known as PM_{10}, and fine particulate matter – known as $PM_{2.5}$ at sites across the borough, although mostly concentrated in the King's Lynn urban area. The latest available ratified data are for 2019.

3.3.5 The highest annual mean NO_2 concentration for 2019 was 42.4$\mu g/m^3$ at a roadside monitoring site on Railway Road (site 2), within the Town Centre AQMA. This is the only site for 2019 exceeding the 40$\mu g/m^3$ objective. No

exceedances of the 1-hour mean NO_2 objective (200µg/m^3 not to be exceeded more than 18 times a year) have been reported.

3.3.6 The highest annual mean PM_{10} concentration for 2019 was 16µg/m^3 at the Gaywood roadside monitoring site in King's Lynn. This site also recorded the most days (5) in 2019 where the 24-hour mean PM_{10} concentration exceeded 50µg/m^3. No exceedances of the annual mean PM_{10} objective (40µg/m^3) or 24-hour mean PM_{10} objective (50µg/m^3 not to be exceeded more than 35 times a year) have been reported.

3.3.7 The highest annual mean $PM_{2.5}$ concentration for 2019 was 7µg/m^3 at roadside monitoring sites on Estuary Road in King's Lynn, and Wretton Road, Stoke Ferry. No exceedances of the annual mean $PM_{2.5}$ objective (25µg/m^3) have been reported.

3.3.8 Defra, in reporting compliance with mandatory EU limit values for air pollutants, has identified the 'Eastern Zone' of the UK (which includes Norfolk) as non-complaint with the limit value for annual mean NO_2 at several roadside locations. However, none of these are within the BCKLWN area. The highest predicted roadside annual mean NO_2 concentration for 2019 is 24.4µg/m^3 on the A148 Gaywood Road in King's Lynn, which is well below the 40µg/m^3 limit value.

3.3.9 It can be concluded from the available evidence that local air quality in the vicinity of the scheme is likely to be good, with pollutant concentrations below air quality objectives and limit values.

Sensitive receptors

3.3.10 Sensitive receptors include:

- Residential dwellings, schools and hospitals. Where there is a risk of exceedance of the 1-hour objective for NO_2 sensitive receptors will also include gardens and external public spaces.
- Designated habitats - including 'Ramsar' sites, Special Protection Areas, Special Areas of Conservation, Sites of Special Scientific

Interest as well as Ancient Woodland, Local Nature Reserves/Wildlife Sites, Nature Improvement Areas and veteran trees - where there are features sensitive to changes in nitrogen deposition.

3.3.11 Receptors will only be sensitive within 200m of construction activities and the ARN. Beyond 200m all impacts are very unlikely to perceptible and any effect will not be significant.

3.3.12 In considering local air quality impacts, a limited number of receptors will be selected that are representative of worst-case exposure, either in terms of the highest pollutant concentrations or where the largest changes in air quality are anticipated.

Proposed baseline data collection

3.3.13 The latest available data will be obtained and reviewed when undertaking the air quality assessment.

3.4 Mitigation measures

3.4.1 Mitigation will be required to minimise the impacts of emissions from construction phase activities. The contractor will need to demonstrate 'Best Practicable Means' to minimise the impacts by adopting appropriate measures throughout the construction programme, in-line with industry best practice to minimise the risk of causing a significant effect.

3.4.2 Best practice mitigation will be required to control dust and emissions from construction works and plant during the construction phase. These measures will be set out in the scheme Construction Environmental Management Plan (CEMP) and implemented by the contractors undertaking the works.

3.4.3 No specific mitigation requirements have been identified at this stage for the operational phase.

3.5 Description of likely significant effects

Construction

3.5.1 Dust emissions associated with construction activities could affect sensitive receptors that are within 200m through increased soiling of exposed surfaces. This could result in a significant effect in terms of complaints and statutory nuisance if appropriate mitigation is not implemented.

3.5.2 Combustion related emissions from on-site plant and vehicles would also occur during construction and could affect local air quality. Traffic management measures during construction may also lead to changes in vehicles emissions which may, in turn, result in impacts on local air quality. Providing mitigation measures are in place during the construction phase, the changes in local air quality are expected to be not significant. DMRB LA 105 notes that *"If the construction activities are less than 2 years it is unlikely that the construction activities would constitute a significant air quality effect or impinge on the UK's reported ability to comply with the Air Quality Directive [Ref 4.N] given the short-term duration of the construction activities as opposed to the long-term operation of the project."* Once construction traffic data become available this position will be reviewed and the BCKLWN will be consulted on whether consideration of this aspect can be scoped out or is to be included.

Operation

3.5.3 The scheme is expected to result in changes to emissions of NO_x, NO_2, PM_{10} and $PM_{2.5}$ along the A47 and A10 and linked routes as a result of changes in traffic flows and speeds.

3.5.4 The scheme, leading to an overall redistribution of traffic along the A47 and A10 (south of West Winch), is also expected to reduce congestion and provide more consistent traffic speed.

3.5.5 The scheme could result in both beneficial and adverse changes to local air quality, depending on the specific changes to emissions from road traffic in the vicinity of individual receptors. According to DMRB LA 105, an effect

would only be significant where existing exceedance of an objective or limit value is made worse by more than an imperceptible amount, or new exceedance occurs. In the case of any designated habitat site, the significance of effect would need to be determined in consultation with the WSP Ecologist.

3.6 Enhancement measures

3.6.1 At this stage, no enhancement measures are proposed. Opportunities to enhance local air quality will be considered further in the air quality assessment.

3.7 Proposed assessment methodology

Construction

3.7.1 A qualitative assessment of construction dust impacts will be undertaken using DMRB LA 105 methodology. The assessment will identify sensitive receptors within 200m of indicative worksite areas and inform the requirements for dust mitigation measures.

3.7.2 The need to assess local air quality impacts due to construction traffic will be reviewed when the necessary data become available. This review will account for the available construction programme and traffic forecast information and will be undertaken in consultation with BCKLWN.

Operation

3.7.3 A detailed level of assessment will be undertaken to determine the impacts on local air quality in the opening year of the scheme. This will involve modelling using ADMS-Roads dispersion modelling software (Cambridge Environmental Research Consultants Ltd. ADMS-Roads)to predicted road traffic contributed ambient pollutant concentrations at receptors. The following scenarios will be modelled:

- Base year (2018); and
- Opening year (2026) do-minimum and do-something.

3.7.4 Subject to review of construction traffic data, an interim year may also be assessed.

3.7.5 Road source emissions of NO_x, PM_{10} and $PM_{2.5}$ will be determined using the traffic data for each scenario and the latest version of Defra's Emissions Factors Toolkit (Local Air Quality Management (LAQM) Support Website | DEFRA). The emissions data will be input to the ADMS-Roads model for each scenario. Unless there is compelling local evidence to suggest otherwise, Defra's future year forecasts for vehicle emissions will be assumed.

3.7.6 Models will be run using 1-year of hourly sequential meteorological data for 2019 from Marham, which is the nearest representative weather station.

3.7.7 The latest background pollutant concentration data from Defra**Error! Bookmark not defined.** will be used to determine total annual mean pollutant concentrations of NO_2, PM_{10} and $PM_{2.5}$ from model outputs for each scenario. The latest version of Defra's NO_x to NO_2 calculator**Error! Bookmark not defined.** will be used to derive road NO_x concentrations from Borough Council of Kings Lynn and West Norfolk NO_2 diffusion tube data to enable base year dispersion model verification in accordance with Defra LAQM.TG(16) (Department for Food, Environment and Rural Affairs. Local Air Quality Management Technical Guidance (TG16)). The NO_x to NO_2 calculator will also be used to derive total NO_2 concentrations from modelled road NO_x.

3.7.8 Where designated habitat sites with sensitive features are identified within 200m of the ARN, nitrogen deposition will be calculated for each scenario with reference to DMRB LA 105 guidance. Data from the Joint Nature Conservation Committee's Air Pollution Information System website (Joint Nature Conservation Committee. Air Pollution Information System) will be used to inform the assessment, and the WSP Ecology topic specialist for the scheme will be consulted in determining the significance of effect.

Significance criteria

3.7.9 DMRB LA 105 will be used to determine:

- Impacts and significance of effects; and
- Compliance with EU limit values.

3.8 Assessment assumptions and limitations

3.8.1 The air quality assessment will be based upon the best information that is available at the time. Some of this information will be based on modelling undertaken by others. Any modelling is subject to uncertainty. The relevant assessment assumptions and limitations will be addressed in the Air Quality chapter of the ES.

3.9 Factors and elements scoped in and out of further assessment

3.9.1 The factors to be scoped in for further assessment are summarised in Table 3.1.

Table 3.1 – Air Quality elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Change in dust and PM_{10} concentrations at sensitive receptors within 200m of the site boundary.	Construction	Yes	No	Potential impacts around areas with sensitive receptors where construction activities will take place.
Change of NO_2, PM_{10} and $PM_{2.5}$ concentrations at sensitive receptors within 200m from the affected road network associated with construction and operational traffic.	Construction and Operation	Yes	No	Changes in traffic emissions along the A47, A10 and linked routes.

Element	Phase	Scoped In	Scoped Out	Justification
Changes of NO_X concentrations and nitrogen deposition rates at designated sites within 200m from the affected road network.	Operation	Yes	No	Changes in traffic emissions along the A10.
Change in dust and PM_{10} concentrations at receptors beyond 200m from the site boundary.	Construction	No	Yes	Changes beyond 200m from the site boundary are unlikely to give rise to significant impacts*.
Change of NO_2, PM_{10} and $PM_{2.5}$ concentrations at receptors beyond 200m from the affected road network associated with construction and operational traffic.	Construction and Operation	No	Yes	Changes beyond 200m from the affected road network are unlikely to give rise to significant impacts*.
Changes of NO_X concentrations and nitrogen deposition rates within Setchey SSSI associated with operational traffic.	Operation	No	Yes	This is a SSSI identified with a geological interest. No sensitive features have been identified with respect to air quality.

Note: * DMRB Guidance Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques. Part 1 HA 207/07 Air Quality.

4 Archaeology and heritage

4.1 Study area

4.1.1 In accordance with DMRB Volume 11, Section 3 Part 2: HA 208/07, a 500m study area from the scheme is generally adopted for buried heritage assets, with a 1km study area adopted for built heritage assets. However, it is considered that a wider study area would be required to characterise the archaeology of the surrounding area in this instance. Therefore, a study area of 1km is proposed for both buried and built heritage assets.

4.2 Consultation

Consultation undertaken to date

4.2.1 No consultation has been undertaken to date.

Proposed consultation

4.2.2 Consultation, if necessary, would be undertaken with the Local Planning Authority archaeological advisor and conservation officer.

4.3 Baseline conditions

Baseline data collected to date

4.3.1 The National Heritage List for England shows that there are no designated (protected) heritage assets on the route corridor.

4.3.2 The following listed buildings lie within the 1km study area:

- The Old Rectory (Grade II), 25m east of the scheme;
- North Runcton Lodge (Grade II), 350m east of the scheme;
- North Runcton War Memorial (Grade II), 825m east of the scheme;
- Church of All Saints (Grade I), 850m east of the scheme;
- Church of St Mary (Grade II*), 450m west of the scheme;
- The Mill at TF 6314 1678 (Grade II), 675m west of the scheme;

- Old Dairy Farmhouse (Grade II), 925m west of the scheme;
- The Gables (Grade II), 700m south of the scheme;
- Bull Cottage and the Alehouse, formerly listed as the Bull Inn (Grade II), which consists of three cottages, 950m south of the scheme;
- West Winch War Memorial (Grade II), 450m west of the scheme; and
- Fife Fishing Disaster Monument at Hardwick Cemetery (Grade II), 825m north of the scheme.

4.3.3 There are no other designated assets, (World Heritage Sites, Scheduled Monuments, Conservation Areas, Registered Park and Gardens and Registered Battlefields) within the study area. The locations of designated assets within the 1km study area are shown within the Designated Heritage Assets Plan (refer to Figure 4.1 in Appendix C).

4.3.4 The scheme passes through open fields outside known areas of historic settlement. Online Norfolk Historic Environment Record data show the scheme passes through an area of a prehistoric burnt mound, undated ditches, the findspots of Saxon and medieval pottery and an area of excavation that recorded a Roman well and medieval pottery. A Roman settlement and industrial site is noted close to the northern part of the scheme.

Proposed baseline data collection

4.3.5 In order to determine the full historic environment potential of the site, a broad range of standard documentary and cartographic sources, including results from any relevant archaeological investigations it will be examined in order to determine the likely nature, extent, preservation and significance of any known or possible buried heritage assets that may be present within the study area. This would include a detailed baseline compiled through a broad and standard range of data sources, including the Norfolk Historic Environment Record, the Historic England National Heritage List for England and National Record for the Historic Environment, local authority data sources along with

published works and cartographic sources, and topographic, geology and geotechnical data, where available.

4.3.6 The assessment would also include a site walkover inspection to determine the topography of the site and existing land use/the nature of the existing buildings on the site, and to provide further information on areas of possible past ground disturbance and general historic environment potential.

4.3.7 The factors to be scoped in for further assessment are summarised in Table 4.1

Table 4.1 – Summary of archaeological and cultural heritage data sources to be consulted

Source	Data	Comment
Historic England	National Heritage List for England with information on statutorily designated heritage assets	Statutory designations (scheduled monuments; statutorily listed buildings; registered parks and gardens; historic battlefields) can provide a significant constraint to development.
Norfolk County Council	Norfolk Historic Environment Record	Primary repository of archaeological information. Includes information from past investigations, local knowledge, find spots, and documentary and cartographic sources
Historic England	National Record of the Historic Environment	National database maintained by Historic England. Not as comprehensive as the Historic Environment Record but can occasionally contain additional information. Accessible via Pastscape website. This would be consulted for the scheme and its immediate vicinity only.
Local Planning Authority	Conservation Area, Archaeological priority area	Area of interest identified by the local authority. Conservation areas hold special architectural or historic interest.

Source	Data	Comment
British Geological Survey (BGS)	Solid and drift geology digital map; online BGS geological borehole record data.	Subsurface deposition, including buried geology and topography, can provide an indication of potential for early human settlement, and potential depth of archaeological remains.
Landmark Information Group	Ordnance Survey maps from the 1st edition (1860–70s) to present day	Provides a good indication of past land use and impacts which may have compromised archaeological survival. Provides an indication of the possible date of any buildings.
Norfolk Record Office, Norwich	Historic maps (e.g. Tithe, enclosure, estate), published journals and local history	Provides baseline information on the historic environment.
Historic England Archive, Swindon	Vertical and specialist (oblique) aerial photographs	Cropmarks formed by moisture variations due to subsurface features can indicate the presence of archaeological remains. Aerial photographs can also sometimes provide information on ground disturbance.
Internet	Web-published local history; Archaeological Data Service	Many key documentary sources, such as the Victoria County History and local and specialist studies are now published on the web and can be used to inform the archaeological and historical background. The Archaeological Data Service includes an archive of digital fieldwork reports.
Norfolk County Council	Project acquired geotechnical data	The information can be very useful in enhancing understanding of the nature and depth of natural geology (as above) and any made ground, whether it is modern or of potential archaeological interest.

Source	Data	Comment
Norfolk County Council	Topographical survey data	Survey data can provide an indication of the impact of past land use, e.g. ground raising or lowering, which is useful for understanding possible truncation and likely depth of archaeological remains.
Norfolk County Council	Proposed Development drawings (architectural and engineering plans and sections).	Assists in the assessment of the extent of the proposed impact upon known or possible archaeological remains.

4.4 Mitigation measures

4.4.1 An appropriate mitigation strategy would aim to reduce or offset any significant adverse effects identified for archaeology and cultural heritage. For archaeology the mitigation strategy would be determined by the results of an evaluation which would consist of a geophysical survey to be followed by trial trenching, if required.

4.4.2 Measures to mitigate effects would normally consist of design adjustments, to allow significant resources to be protected and retained (preservation *in situ*) or, where this is not feasible, investigation and recording before and during development, with dissemination at an appropriate level (preservation by record). The level of mitigation would be, in each case, proportionate to the significance of the asset being affected.

4.5 Description of likely significant effects

4.6 The factors to be scoped in for further assessment are summarised in Table 4.2.

Table 4.2 – Likely significant effects associated with heritage assets

Effect	Receptor	Applicable Phase
Ground disturbance	Known or possible buried heritage assets, historic landscape and hedgerows	Enabling works and construction phase
Minor to Major adverse effect on setting. Visual impact of the road and footbridge, including traffic and lighting. Increased traffic noise.	Nearby listed buildings	Operational phase

4.7 Enhancement measures

4.7.1 No enhancement measures are currently proposed.

4.8 Proposed assessment methodology

4.8.1 The assessment of potential effects on heritage assets in the ES will include:

- Identifying heritage assets that may be affected by the scheme;
- Evaluating the significance of heritage assets, based on existing designations and professional judgement where such resources have no formal designation and considering archaeological, historical, and architectural values as outlined in Historic England's Conservational Principles (2017 consultation draft). This will consider factors which may have affected asset survival;
- Predicting the magnitude of change (impact) upon the known or potential heritage significance of archaeological and heritage assets during the construction and operation phase and the likely resulting significance of environmental effect; and
- Considering the mitigation measures that have been included within the scheme design and any additional mitigation that might be required

to avoid, prevent, reduce or, if possible, offset likely significant adverse effects.

4.8.2 The ES chapter would be supported by a technical appendix in the form of a full illustrated Historic environment desk-based assessment.

4.8.3 The assessment would be undertaken in accordance with the requirements of the National Planning Policy Framework and to standards specified by the Chartered Institute for Archaeologists, Historic England and the Institute for Historic Building Conservation and by DMRB.

Proposed Significance Criteria

4.8.4 The value and 'significance' of heritage assets will be determined through statutory designation and/or professional judgement against the values referred to in the National Planning Policy Framework, in Historic England Conservation Principles (November 2017) and in DMRB Volume 11, Section 3 Part 2: HA 208/07. The magnitude of impact and significance of effect on heritage assets will be determined through criteria outlined in DMRB Volume 11, Section 3 Part 2: HA 208/07 and through professional judgement.

4.9 Assessment assumptions and limitations

4.9.1 Best endeavours have been made to ensure that the baseline data is accurate and up to date. It is assumed that information on the Historic Environment Record database is accurate.

4.9.2 The main limitation to the assessment of effects on buried heritage assets is the nature of the archaeological resource – buried and not visible – which means it can be difficult to predict accurately the presence and likely significance of buried heritage assets, and the impact of the scheme upon such assets, based primarily on a desk-based sources. The principle sources of information on heritage resources are the Historic Environment Record and the National Record for the Historic Environment, which list all known archaeological sites and finds. This information provides an initial indication of assets present rather than a definitive list of all potential archaeological assets

because the full extent of a buried heritage resource cannot be known prior to site-specific archaeological field investigation.

4.9.3 Current understanding may be limited, in particular for periods not present or poorly presented in the historical record (prehistoric, Roman and early medieval periods) where no past archaeological investigation of the site has been carried out. Therefore, the presence and extent, date, nature, survival and significance of possible, previously unrecorded, buried heritage assets are largely uncertain.

4.9.4 Where information is not available, professional judgement will be used to assess archaeological potential. This approach is based on other relevant data, for example the nature and depth of subsurface geological deposits as noted in geotechnical surveys and BGS data (this can provide an indication of the likely nature, depth, and survival of archaeological remains, if present), and the history of past land use as shown on historic maps (which is useful for determining likely truncation and survival).

4.9.5 Notwithstanding these limitations, the methodology proposed here is considered robust, utilising reasonably available information, and conforms to the requirements of local and national guidance and planning policy.

4.10 Factors and elements scoped in and out of further assessment

4.11 The factors to be scoped in for further assessment are summarised in Table 4.3

Table 4.3 – Archaeology and cultural heritage elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Construction effects (Grade II listed The Old Rectory)	Construction	Yes	No	The asset is located in the immediate vicinity of the site. Potential for physical impacts from construction phase activities.
Construction effects (other built heritage assets)	Construction	No	Yes	Construction phase activities are short-term and temporary. The impacts from the phases of construction activities are not considered to be a significant change and have therefore been scoped out.
Construction effects (buried heritage assets)	Construction	Yes	No	There is the potential for significant effects on heritage assets during enabling and construction works.
Operational effects (built heritage assets)	Operation	Yes	No	There is the potential for impacts to the setting of heritage assets during the operational phase.

Element	Phase	Scoped In	Scoped Out	Justification
Operational effects (buried heritage assets)	Operation	No	Yes	Operational (completed development) impacts are expected to represent insignificant environmental effects for buried heritage assets on the basis that once the proposed development has been completed, no further ground disturbance would occur and consequently there would be no additional impacts or resulting environmental effects.
Cumulative effects (buried heritage assets)	Construction and Operational	No	Yes	An assessment of cumulative effects has been scoped out. Cumulative effects are 'elevated' effects which occur where the combined effect of the scheme with other proposed schemes in the vicinity, on a discrete and significant shared heritage asset/resource, is more severe than that reported at the site. This is on the basis that for intangible and deeply buried heritage assets it is not feasible to quantify accurately the nature of the resource across the assessment study area, which would enable the identification of a cumulative impact and potential elevated effect.

5 Biodiversity

5.1 Study area

5.1.1 The zone of influence (ZOI) for the scheme will include all ecological features that may be subject to biophysical changes resulting from the scheme due to ecological or hydrological links. All ecological features within the scheme boundary could be directly affected through construction, due to removal of vegetation, topsoil stripping and excavation.

5.1.2 Disturbance through noise, lighting and dust may also affect adjacent habitats and the species that are using them. Therefore, an initial 250m radius around the scheme boundary has been adopted to represent this ZOI, although this buffer has been tailored to suit the lay of the land (such as significant barriers such as A roads and residential areas) and the typical distribution of each species. This ZOI will be of particular importance for mobile species requiring survey.

5.1.3 The desk study will take in an extended study area in keeping with current guidance (Guidelines for Ecological Impact Assessment (EcIA) | CIEEM). The following Study Areas apply to statutory and non-statutory designated sites:

- European (In relation to the UK's exit from the European Union, the Department for Environment Food and Rural Affair published a policy paper in January 2021 detailing changes to the Habitats Regulations (2017). This refers to the establishment of a national site network of 'protected sites') and internationally designated Sites: Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites: 10km from the scheme;
- All SACs designated for bats: 30km from the scheme;
- Nationally designated sites, such as Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs): 2km from the scheme; and

- Locally designated sites (e.g. County Wildlife Sites): 2km from the scheme.

5.1.4 Defined Surveys Areas for individual ecological features have been informed by published guidance on likely ZOIs. These are as follows:

- Habitats and botanical features: within the scheme boundary;
- Wintering and breeding birds: 250m from the scheme boundary;
- Bats: All trees within the scheme and up to 25m from the scheme boundary and all buildings within 50m of the scheme boundary that are considered likely to impacted by the proposals;
- Badger: 50m from the scheme boundary;
- Water Vole: within the scheme boundary but extended to nearby water courses where directly connected;
- Otter: Within the scheme boundary but extended to nearby ponds where directly connected;
- Great Crested Newts (GCN): within and up to 500m beyond the scheme boundary;
- Reptiles: targeted areas within the scheme boundary; and
- Invertebrates: targeted areas within the scheme boundary.

5.2 Consultation

Consultation undertaken to date

5.2.1 Norfolk Biodiversity Information Service (NBIS) have been consulted on details of non-statutory designated sites and records of protected / notable species within 2km of the scheme.

Proposed consultation

5.2.2 Consultation with the BCKLWN and the retained ecologist/NCC County Ecologist will be undertaken to confirm that the proposed scope of ecological surveys is appropriate.

5.3 Baseline conditions

Statutory designated sites

5.3.1 Following information received from NBIS and a review of the Multi Agency Geographic Information for the Countryside (MAGIC), the following statutory designated sites fall within the Study Area:

- **The Wash Ramsar**, approximately 7.5km to the north-west of the scheme. Important for extensive saltmarshes, intertidal banks of sand and mud, shallow waters and deep channels. It is the most important staging post and over-wintering site for migrant wildfowl and wading birds in Eastern England. It supports a valuable commercial fishery for shellfish and also an important nursery area for flatfish. It holds one of the North Sea's largest breeding populations of harbour seal *Phoca vitulin* and in addition to grey seals *Halichoerus grypus*. The sublittoral areas support a number of different marine communities including colonies of the reef-building polychaete worm *Sabellaria spinulosa*;
- **The Wash SPA**, approximately 7.5km to the north-west of the scheme. The Wash is of outstanding importance for a large number of geese, ducks and waders, both in spring and autumn migration periods, as well as through the winter. The SPA is especially notable for supporting a very large proportion (over half) of the total population of Canada/Greenland breeding knot *Calidris canutus islandica*. In summer, the Wash is an important breeding area for terns and as a feeding area for marsh harrier *Circus aeruginosus* that breed just outside the SPA;

- **Roydon Common Ramsar** 5.9km to the north-east of the scheme. Most extensive example of valley mire-heathland biotype within East Anglia. It is a mixed valley mire holding vegetation communities which reflect the influence of both base-poor and base-rich water. The vegetation communities have a restricted distribution within Britain. It also supports a number of acidophilic invertebrates outside their normal geographic range and six British Red Data Book invertebrates;
- **River Nar SSSI**, approximately 700m to the south of the scheme. The River Nar combines the characteristics of a southern chalk stream and an East Anglian fen river. Together with the adjacent terrestrial habitats, the Narr is an outstanding river system of its type. The variation in physical features and the influence of the underlying chalk give rise to a rich and diverse flora. The river corridor is also of considerable importance to wildlife; and
- **Setchey SSSI**, approximately 750m to the south of the scheme. Setchey is a Fenland site, designated for its geological interest. The site is important as part of the overall network of Fenland sites, allowing a correlation across the area from west to east.

5.3.2 The Wash SPA and Ramsar is relatively distant from the scheme (7.5km) and the scheme is considered to have neither functionally linked habitat nor hydrological linkages with this site. Roydon Common Ramsar is also a notable distance from the scheme and separated by several major road systems. Again, no functional linkage is considered to occur with the scheme.

5.3.3 Both of the SSSIs are recognised by Natural England as meeting published criteria for SSSI notification in England and are of national importance. Given that both of these SSSI sites are approximately 750m from the scheme at their closest approach, separated by the existing A10 road and industrial development, it is considered unlikely that the scheme would affect either site. However, the Study Area does lie within the SSSI Impact Risk Zones for both Setchey and the River Nar SSSIs and the land drains may have connectivity

to these sites through the groundwater. Therefore, Natural England will be consulted regarding the scheme.

Non-Statutory Designated Sites

5.3.4 Following information received from NBIS and Natural England, the following non-statutory designated sites fall within the Study Area:

- **Sheep's Course Wood County Wildlife Site** (CWS), The CWS is immediately adjacent to the scheme in the northeast. The Site is Common Land (CL111) with rights for grazing and consists of a broadleaved woodland on acidic, sandy soils. To the north, oak dominates with a sparse understory. Deadwood is frequent throughout and a large seasonally-wet depression occurs near the eastern edge. A dry ditch runs down the western and southern sides of the wood marking the boundary between the site and adjacent plantation woodland in the west and arable field in the south;
- **West Winch Common CWS**, approximately 195m to the west of the scheme;
- **Brook Watering Meadow CWS**, approximately 490m to the west of the scheme. A small, unimproved meadow enclosed by hedgerows and ditches. Predominantly made up of well-drained, neutral grassland over loamy soils, the site is grazed by cattle and cut for hay;
- **Rush Meadow CWS**, approximately 790m to the west of the scheme;
- **Adj. River Narr CWS**, approximately 1.4km to the west of the scheme. Part of a disused railway line close to the River Nar. At either end of the site is neutral unimproved grassland with impeded drainage. At the centre of the site is a small area of fen vegetation dominated by reed *Phragmites australis* and surrounded by dense hawthorn *Crataegus monogyna* scrub;
- **Plantation Wood CWS**, approximately 1.6km to the north east of the scheme;

- **South of Gaywood Park CWS**, approximately 1.8km to the north west of the scheme. A small triangular site bounded by two railway lines, one disused. The site is enclosed by residential and industrial development. Habitats include areas of unimproved, neutral dry grassland along the western boundary with lower, wetter areas in the centre;
- **Saddlebow Reedbeds CWS**, approximately 2km to the west of the scheme. A large area of fen with a small area of encroaching scrub. It is surrounded by earth banks colonised by tall herb species. Considered an important local habitat for many bird species; and
- **Old Hall Farm CWS**, approximately 2km to the east of the scheme. An area of species-rich unimproved neutral grassland with impeded drainage.

Habitats

Desk study

5.3.5 Habitats of Principal Importance (Section 41 of the Act requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The list has been drawn up in consultation with Natural England, as required by the act.) (including those mapped on Natural England's priority habitat inventory GIS data available on MAGIC map) located within or directly connected to the scheme are:

- Hedgerows;
- Lowland mixed deciduous woodland;
- Arable field margins; and
- Ponds

Field survey

5.3.6 Table 5.1 outlines the habitats recorded during an initial Phase 1 Habitat Survey in 2019 comprised broad-leaved woodland, dense/continuous scrub, scattered scrub, improved grassland, semi-improved grassland, standing water, dry ditch, arable, introduced shrub, intact hedge and earth bank.

5.3.7 Access was restricted for the initial Phase 1 survey and therefore a detailed assessment of each habitat was not possible, and their importance is yet to be determined. An updated Phase 1 Habitat Survey and detailed botanical surveys are therefore required in 2021 in order to establish this element of the baseline.

Table 5.1 - Phase 1 Habitat areas recorded in 2019

Phase 1 Habitat Type	**Description**
Broadleaved Woodland (A1.1.1)	Sheep's Course Wood, a CWS consisting of broadleaved woodland, is directly adjacent to the scheme in the northeast. This woodland consisted of a largely oak *Quercus robur* canopy with hazel *Corylus avellana* and holly *Ilex aquifolium* understory. Ground flora species present included ground ivy Glechoma hederacea with honeysuckle *Lonicera periclymenum* also recorded. Areas of the wet woodland and scrub are also present within the north of the site. Species included common alder *Alnus glutinosa* and willow *Salix sp.*

Phase 1 Habitat Type	Description
Dense/Continuous Scrub (A2.1)	A small parcel of dense scrub was recorded within the Survey Area. This formed part of a larger stand of dense scrub, covering approximately 1.7ha in total. The predominant species present was gorse *Ulex europaeus.*
Scattered Scrub (A2.2)	Parcels of scattered scrub were recorded in the north of the Survey Area. This habitat was present along approximately 145m of the southwest side of the A47 and along approximately 370m to either side of the northern portion of the scheme . Species recorded included oak saplings *Quercus robur*, hawthorn *Crataegus monogyna*, ragwort *Senecio jacobaea*, fleabane *Pulicaria dysenterica*, knapweed *Centaurea nigra* and goat willow *Salix caprea.*
Improved Grassland (B4)	A small area of improved grassland, approximately 0.65ha, was present within the Survey Area. This formed part of a larger field, the total area of which was approximately 1.75ha.

Phase 1 Habitat Type	Description
Semi-Improved Grassland	Two areas of semi-improved grassland were recorded within the Survey Area. In the south, an area approximately 1.68ha in size was recorded and in the north a larger area of approximately 3.88ha was present. Species recorded within the grassland in the north included knapweed *Centaurea nigra*, fleabane *Pulicaria dysenterica* and buttercup *Ranunculus* sp. This area was considered to have a good thatched quality.

Phase 1 Habitat Type	Description
Standing Water (G1)	Two ponds were present within the Survey Area, though both were dry at the time of survey. Flora species recorded in both included thistle *Cirsium* sp., nettle *Urtica dioica*, ash Fraxinus excelsior, hawthorn *Crataegus monogyna*, ivy Hedera helix, and bramble *Rubus fruticosus* agg. In one of the ponds dog rose *Rosa canina*, willow *Salix sp*., elm *Ulmus sp*., and cock's-foot *Dactylis glomerata* were also recorded. A ditch was recorded towards the north of the Survey Area, crossing from west to east. This feature was approximately 4m wide at the top, reducing to 1m wide at the bottom and 2m deep. At the time of survey, it was wet along most of its length, being partly dry where a mature tree was recorded.
Dry Ditch J2.6	A number of drainage ditches fall within the Survey Area and will be impacted by the scheme.
Arable (J1.1)	The dominant habitat type present within the Survey Area was arable land, with a number of arable fields recorded along the length of the scheme.
Introduced Shrub (J1.4)	Three small areas of introduced shrub, in the form of gardens, were recorded within the Survey Area. Two of these were located to the west of the existing A10 road.

Phase 1 Habitat Type	Description
Intact Hedge (J2.1)	The Survey Area included parts of three intact hedgerows. Two of these bounded either side of Rectory Lane, which crosses the scheme (towards the centre) and the third was present along the southern edge of the area of scattered scrub and woodland in the north.
Earth bank (J2.1)	An earth bank was recorded along the southern boundary of the semi-improved grassland and scrub habitats in the north of the Survey Area.

Species

5.3.8 The Study Area defined in section 5.1 is considered to offer potential to support bats, badgers, otter, water vole, breeding and wintering birds, reptiles, amphibians and invertebrates. More information is provided in Table 5.2 below which presents an overview of desk study results and likely suitability for the scheme to support populations.

Table 5.2 – Existing species baseline

Species	Desk Study	Suitability of the Scheme
Bats	No records of bat roosts were provided within the bat Survey Area. NBIS returned records of roosting, commuting and foraging bats within 2km of the Survey Area comprising of seven species which were common pipistrelle Pipistrellus; soprano pipistrelle Pipistrellus pygmaeus; Nathusius' Pipistrelle Pipistrellus nathusii; brown long-eared bat Plecotus auritus, noctule Nyctalus noctula; serotine bat Eptesicus serotinus; and barbastelle bat Barbastella barbastellus. In addition, records of Myotis sp. and pipistrelle bat species Pipistrellus sp. that were not identified to species level were provided. The closest records were for common pipistrelle, soprano pipistrelle, brown long-eared bat, noctule and barbastelle, which were all recoded within an area of grassland and scrub near to the scheme boundary. The most recent records were from 2016 and included common pipistrelle, Nathusius' pipistrelle and noctule species to the west of the Survey Area, the closest records being approximately 305m away. Soprano pipistrelle and brown long-eared bats were recorded as roosting in 2016; this included a maternity roost of soprano pipistrelle over 1.8km to the northwest of the Survey Area, within King's Lynn, and a record of a brown long-eared bat roosting in a building approximately 340m to the west of the Survey Area.	The Survey Area and wider landscape provide varying levels of suitability for roosting, foraging and commuting bats.

Species	Desk Study	Suitability of the Scheme
Badgers	NBIS returned one record of badger Meles within the Survey Area from 2016, recorded as dead on the A10 at Setchey, at the southern end of the scheme.	The habitats recorded within the Survey Area are considered suitable for supporting badger.
Otter	NBIS returned three records for otter Lutra within 2km of the Survey Area. The nearest record was for a road casualty on the A10 close to the River Nar approximately 735m to the south of the Survey Area.	The River Nar is within 2km of the Survey Area and runs roughly parallel for the length of scheme. This provides good quality habitat for otter. Ditches present within the Survey Area may provide some suitable habitat for otter.
Water Vole	NBIS returned four records of water vole Arvicola amphibius within 2km of the scheme, all within King's Lynn to the north of the Survey Area.	There are ditches present within the Survey Area and surrounding habitats which provide potential habitat for water vole.

Species	Desk Study	Suitability of the Scheme
Birds	NBIS returned two records for barn owl Tyto alba within 300m of the scheme, which are listed on Schedule 1 of the Wildlife and Countryside Act (1981, as amended). Records were returned for seven Red List (Birds of Conservation Concern (Eaton MA, Aebischer NJ, Brown AF, Hearn RD, Lock L, Musgrove AJ, Noble DG, Stroud DA and Gregory RD (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds 108, 708–746)) species including skylark Alauda arvensis, linnet Linaria cannabina which are all Species of Principal Importance (SPI).	Habitats within the Survey Area and wider area were considered suitable to support wintering and breeding birds. The Survey Area also offered potential to support a number of common and widespread species, including SPI.
Reptiles	NBIS returned 11 records of grass snake Natrix helvetica within 2km of the Survey Area. The closest and most recent records are approximately 300m west of the scheme and are from seven dates in the summer of 2016 where adults, sub-adults and juveniles were all recorded.	Habitats recorded within the Survey Area and surrounding land were considered suitable for supporting common widespread reptile species including slow-worm Anguis fragilis, common lizard Zootoca vivipara and grass snake and potentially adder Vipera berus.

Species	Desk Study	Suitability of the Scheme
Amphibians	NBIS returned a record of great crested newt (GCN) Triturus cristatus from 2012 in a pond approximately 415m to the west of the Survey Area, along Main Road in West Winch. No other amphibian records were returned from within 2km of the scheme.	A total of 13 water bodies were identified within a 500m radius of the Survey Area. The habitats within the scheme boundary provide suitable terrestrial habitat for GCN with connectivity to suitable breeding habitat.
Plants	NBIS returned a single record of the invasive Japanese knotweed approximately 350m to the northwest of the scheme.	No detailed botanical surveys were carried out as part of the initial Phase 1 Habitat Survey. Woodland and grassland habitat do however have some potential to support protected or notable plants . The habitats also have the potential to contain invasive non-native plants, including those listed in Schedule 9 of the Wildlife and Countryside Act

Proposed baseline data collection

5.3.9 Further surveys will be required to develop the existing baseline and to establish the importance of the scheme for protected and notable species.

5.3.10 The following survey work will be undertaken during 2020 / 2021 to inform the ES, in accordance with relevant survey guidance:

- Updated Phase 1 Habitat survey (including habitat condition assessment);
- National Vegetation Classification (NVC) survey;
- Hedgerow survey;
- Badger survey;
- Preliminary bat roost classification surveys and elevated inspections;
- Bat activity surveys;
- Bat hibernation surveys;
- Breeding bird surveys;
- Wintering bird surveys;
- Barn owl survey;
- GCN surveys;
- Otter survey;
- Water vole survey;
- Reptile survey;
- Invertebrate survey; and
- Arboriculture survey.

5.3.11 Table 5-3 below provides further information on the justification and survey methodology proposed.

Table 5.3 – Proposed ecological field surveys 2021

Aspect Scoped In	Justification	Survey Methodology
Updated Phase 1 Habitat Survey and Habitat Assessment	The initial Phase 1 Habitat Survey will need to be updated due to changes to the proposal boundaries and limited access during the initial Survey. This data will also be necessary to inform the Biodiversity Net Gain (BNG) Feasibility Assessment. The survey will also identify any invasive non-native plant species present within the RLB.	A Phase 1 habitat survey will be completed across the scheme in line with current guidance. Consultation with Norfolk Biodiversity Information Service (NBIS) for an updated 2km biological record search. Data on habitat condition will also be collected to inform the Biodiversity Net Gain Feasibility Assessment. (JNCC 2010 (Joint Nature Conservation Committee (JNCC) (2010). Handbook for Phase 1 habitat survey - a technique for environmental audit. JNCC, Peterborough) and CIEEM 2018 (CIEEM (2018). Guidelines for Preliminary Ecological Appraisal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester))
Hedgerow	A full hedgerow survey is required to complete the baseline. Surveys will determine if any hedgerows meet the criteria for 'Important' under the Hedgerow Regulations 1997 or as Priority Habitat under the Natural Environment and Rural Communities (NERC) Act 2006. The data will be used to inform mitigation measures for hedgerows within the scheme. This will help to ensure there is no breach of wildlife legislation or planning policy. Additionally, the hedgerow survey data will feed into the BNG assessment work.	All hedgerows that may be directly impacted by the scheme and that have not been previously surveyed in 2019, will be subject to survey to identify their importance in accordance with good practice (The Hedgerow Regulations 1997) and (UK Biodiversity Action Plan Priority Habitat Descriptions).
National Vegetation Classification (NVC)	To assess the importance of the priority habitat i.e. the woodland and grassland habitat impacted by the scheme, a detailed botanical survey will be undertaken which will comprise an NVC survey. Impact pathways include habitat loss. The data has not been previously collected; therefore, it will be used to inform impact assessment and feed into the BNG assessment. This will help to ensure there is no breach of legislation or planning policy.	The sections of woodland and grassland habitat to be impacted by the scheme will be subject to a National Vegetation Classification (NVC) survey (Rodwell, J et al. (2000). Review of coverage of the National Vegetation Classification. Joint Nature Conservation Committee Report No. 302.).

Aspect Scoped In	Justification	Survey Methodology
Biodiversity Net Gain Feasibility Assessment	Although not currently a legal obligation for UK development, the updated National Planning Policy Framework (NPPF) (Ministry of Housing, Communities & Local Government) and (National Planning Policy Framework) refers to net gains in biodiversity in a number of sections. In addition, on 14th March 2019, Her Majesty's Treasury confirmed that following consultation, the government will use the forthcoming Environment Bill to mandate BNG for development in England, ensuring that the delivery of much-needed infrastructure and housing is not at the expense of vital biodiversity. As a consequence of the policy context detailed above, a BNG Feasibility Assessment is proposed to ensure the principles of BNG become enshrined as part of the on-going design of WWHAR. Furthermore, should BCKLWN decide to set the objective of biodiversity net gain for the scheme, early identification of risks and opportunities will be instrumental in helping achieve this aspiration.	WSP has developed a BNG process that is measurable, transparent, consistent, efficient and mitigates programme and budget risks for both developers and decision makers. This process adheres to industry recognised best practice. (BBOP (2012). BBOP Standard on Biodiversity Offsets, CIEEM, IEMA & CIRIA (2016). Biodiversity Net Gain. Good Practice Principles for Development, Defra (2012). Biodiversity Offsetting Pilots: Technical Paper- the Metric for the Biodiversity Offsetting Pilots in England, BRE (2018). GN36 - BREEAM, CEEQUAL and HQM Ecology Calculation Methodology – Route 2). The BNG Feasibility Assessment will look at the feasibility and implications of delivering BNG for the Scheme, in terms of the type and extent of compensatory habitat required. The technical scope of the BNG Feasibility Assessment comprises the following steps a) assessment of the biodiversity baseline, and b) identifying habitat compensation requirements: Meeting with West Norfolk District Council. Telephone meeting to discuss results of the BNG Feasibility Assessment and potential next steps for progressing BNG within the Scheme.
Badger Survey	The scheme comprises habitat that typically supports badger, such as woodland, hedgerows, grassland and arable.	A walk over survey of all areas of habitat suitable to support badger will be undertaken to check for setts, hairs, footprints and latrines within the route corridor. The survey effort may vary over areas of connecting habitat such as woodland, hedgerows and scrub. (Harris et al 1989 (Harris, S., Cresswell, P. and Jefferies, D. (1989). Surveying Badgers. Mammal Society)) (Cresswell et al 1990 (Cresswell P., Harris, S. and Jefferies, D.J. (1990). The History, Distribution, Status and Habitat Requirements of the Badger in Britain. Nature Conservancy Council, Peterborough))

Aspect Scoped In	Justification	Survey Methodology
Bats – Preliminary Roost Classification Surveys, emergence/re-entry surveys and Elevated Inspections (Trees only)	A large number of trees, including a woodland block may have the potential to support tree roosting bats. Any bat roosts in buildings that will be impacted by the scheme will need to be identified and classified to inform the level of mitigation required.	Ground Level Tree Assessment (GLTA) – Trees within the route corridor and up to 25m from the scheme boundary will be inspected from ground level for features that may support roosting bats. Each tree will be graded according to its suitability to support roosting bats in accordance with best practice guidelines. Aerial Tree Inspection – Trees graded as of Moderate to High suitability to support roosting bats (including trees that were too tall to be fully investigated from ground level) will be surveyed by aerial inspection. Climbers will hold a minimum Level 2 Natural England Class Licence to survey for bats and be qualified in tree climbing and aerial rescue. All buildings within 50m of the scheme boundary that are considered likely to impacted by the proposals will be subject to emergence/re-entry surveys in line with current best practice guidelines. A summary of buildings scoped into this assessment and those that are scoped out is included in Appendix B. A minimum of one evening emergence / dawn re-entry surveys will be undertaken per structure (two for moderate and three for high). Surveyors will watch the structure 15 minutes prior to sunset and a minimum of 90 minutes after sunset (vice-versa for dawn surveys). (Collins, 2016 (Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.))
Bats - Activity Survey (using static/automated detector methods)	The woodland, grassland, hedgerows and ponds are suitable for foraging and commuting bat activity.	10 automated, static bat detectors will be placed along sections of impacted habitat (such as a severed hedgerow or edge of woodland) to record bat call data over five consecutive nights. This survey will be repeated at each location once a month (May to September inclusive) in line with good practice guidelines. All data collected will then be subject to analysis using bat sound analysis software. (Collins, 2016(Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.))
Bats – Hibernation Surveys	No survey data relating to hibernating bats has been collected to date, therefore we propose aerial inspections of trees during the hibernation period to help establish the baseline.	Hibernation surveys will be undertaken on trees considered to hold hibernation potential (from GLTA results) Within and up to 25m from the scheme boundary. Surveys will be undertaken in December 2021/January 2022.

Aspect Scoped In	Justification	Survey Methodology
Breeding Bird Survey	The scheme comprised a diverse range of habitats that may support breeding birds. These habitats included, woodland, arable, marsh, scrub and grassland.	Six survey visits will be undertaken throughout the optimal survey period (two visits each in April, May and June). Ornithologists will note all bird activity within the study area and relative territory maps will be created for notable species (Annex 1, Schedule 1, BoCC, SPI and LBAP). (Marchant 1983 (Marchant, J (1983). BTO Common Bird Census Instructions. British Trust for Ornithology)).
Barn Owl Survey	Barn Owls are specifically protected under Schedule 1 of the Wildlife and Countryside Act. The scheme includes potential for breeding and foraging barn owls.	All suitable structures and trees will be subject to an inspection for evidence of, or suitability to support barn owl. In addition to the survey a desk study will involve consultation with the local record centres and bird groups regarding existing barn owl data. (Shawyer, C, (2011). Barn Owl *Tyto alba* Survey Methodology and Techniques for use in Ecological Assessment.)
Wintering Bird Survey	The scheme comprised a diverse range of habitats that may support wintering birds. These habitats included, woodland, arable, marsh, scrub and grassland.	Four survey visits will be made to the Survey Area monthly between November and February. Ornithologists will map the distribution and abundance of all bird species utilising the Survey Area.
GCN – Habitat Suitability Index (HSI), eDNA and Population Estimate Survey	13 ponds were located within 500m of the scheme than may offer potential to support breeding GCN (refer to Environmental Constraints Plan in Appendix B).	All ponds within and up to 500m beyond the scheme boundary will be subject to an HSI survey and an eDNA survey by a licensed surveyor who will be supported by a health and safety second. Population estimate surveys – All ponds within 250m of the RLB and those within 250-500m that are deemed to be impacted by the scheme that return a positive eDNA result for GCN will be subjected to further population estimate surveys. GCN typically reside within terrestrial habitat up to 250m from breeding water bodies unless the only suitable habitats are linear features such as arable field margins and hedgerows. In which case, GCN can be found up to 500m from breeding ponds. Population estimate surveys comprise six visits between late April and the end of June using bottle trapping, torch light surveys and egg searching techniques. (Langton et al 2001 (Langton, T., Beckett, C and Foster, J (2001). Great Crested Newt Conservation Handbook. Frogilife, Halesworth.); Oldham et al 2000 (Oldham, R et al (2000). Evaluating the suitability of habitat for the Great Crested Newt (Triturus cristatus). Herpetological Journal 10(4), 143-155); & Biggs et al 2014 (Biggs, J et al (2014). Analytical and methodological development for improved surveillance of the Great Crested Newt. Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (Triturus cristatus) environmental DNA. Freshwater Habitats Trust, Oxford.))

Aspect Scoped In	Justification	Survey Methodology
Terrestrial Invertebrate Survey	The scheme has the potential to impact on habitat with the potential to support notable terrestrial invertebrate species.	Survey will comprise mid-spring and early summer surveys of invertebrates and associated identification. The surveys will target habitats considered likely to support notable invertebrate assemblages. During the survey, the entomologist will collect terrestrial invertebrates through a combination (where appropriate) of sweep netting, beating (of scrub), grubbing, pan trapping, hand searching, light trapping and pitfall trapping (Drake, C.M., Lott, D.A., Alexander, K.N.A and Webb, J (2007). Natural England Research Report NERR005: Surveying terrestrial and freshwater invertebrates for conservation evaluation. Natural England.). Sampling of terrestrial invertebrates will cover groups most closely associated with habitats found across the study area, including Coleoptera (beetles), Diptera (larger Brachycera (flies)), Lepidoptera (butterflies and moths) aculeate Hymenoptera (bees, ants and wasps) and Hemiptera (true bugs).
Otter Survey	In addition to the ditches that intersected the arable land, the River Nar runs roughly parallel for the length of scheme route.	All watercourses that will be crossed by the preferred route will be subject to two otter surveys (one in spring and one in autumn). As works may require permanent culverting of watercourses, the field survey will include upstream and downstream of the work (proportionate to the likely fragmentation effects). (Chanin 2003 (Chanin, P (2003). Ecology of the European Otter. Conserving Natura 2000 Rivers, Ecology Series No. 10. English Nature, Peterborough))
Reptile Presence/Absence Survey	Habitats recorded within the Survey Area and surrounding land were considered suitable for supporting common widespread reptile species including slow-worm, common lizard and grass snake and potentially adder.	The key areas of suitable reptile habitat along the route corridor will be subject to reptile presence / absence surveys where these species are likely to occur. Surveyors will install artificial refugia across areas of suitable habitat and undertake a minimum of seven checks during optimal conditions. (Froglife 1999 (Froglife (1999). Reptile survey; an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Froglife, Halesworth)) (Gent and Gibson 2003) (Gent, T. and Gibson, S. eds (2003). Herpetofauna Workers Manual. JNCC, Peterborough))
Water Vole Survey	There are ditches present within the Survey Area and surrounding habitats which may provide potential habitat for water vole.	All watercourses that will be crossed by the preferred route will be subject to two water vole surveys (one in spring and one in autumn). As works may require permanent culverting of watercourses, the field survey will include upstream and downstream of the work (proportionate to the likely fragmentation effects). (Strachan and Moorhouse 2006 (Strachan, R and Moorhouse, T (2006). Water vole conservation handbook 2nd Edition. Wildlife Conservation Research Unit, Oxford))

Arboriculture

5.3.12 The scope of work is to survey all qualifying trees located within the arboriculture study area (mainly at the extent of the scheme corridor and provide a Detailed Arboricultural Report which will identify the direct and indirect effects of the scheme on existing trees and will put forward proposals for suitable mitigation measures where required. The Detailed Arboricultural Report, which will support the ES, will contain a Tree Survey Schedule, Arboricultural Impact Assessment, Arboricultural Method Statement and Tree Protection Plan(s).

5.3.13 A Tree Constraints Plan will also be provided to support the ES. This will identify the above and below spatial constraints of the existing trees including their quality, position, crown spreads and root protection areas. Qualifying trees are defined as individual trees with a stem diameter of at least 75mm measured at 1.5m above ground level and any tree whose Root Protection Area (RPA) while it falls outside the scheme red line boundary (RLB) but whose RPA may extend to within the RLB and may be affected by any future development works.

5.3.14 Qualifying trees will be inspected and classified, by a suitably qualified and experienced arboriculturist in accordance with BS 5837:2012 Trees in relation to design, demolition and construction – Recommendations [BS 5837].

5.3.15 To allow the assessment of trees on site to be completed in a practicable way and to best reflect the tree population on site, where trees form groups either aerodynamically, through mutual support or by forming a screen or other such feature they will be recorded as such. This method is supported by paragraph 4.4.2.3 of BS 5837.

5.3.16 All qualifying trees will be inspected from ground level using the Visual Tree Assessment (VTA) method. The VTA will be undertaken on the above ground portion of the trees. No aerial inspection, internal sampling or excavation will be undertaken, nor will any laboratory testing be carried out. Binoculars may

be used to inspect the upper parts of the tree canopy from ground level if required.

5.4 Biodiversity net gain

5.4.1 The National Planning Policy Framework (NPPF) places a responsibility on local planning authorities to encourage net gains for biodiversity through plans and projects. Biodiversity net gain is also expected to be made mandatory for development projects through the Environment Bill, which is currently being progressed through Parliament.

5.4.2 Habitat classification surveys and condition assessments will be undertaken to inform the baseline biodiversity value of the scheme prior to development. A biodiversity calculator (likely Biodiversity Metric 3.0 which is expected to be released in Spring 2021) will be used to determine the change in biodiversity value at though the scheme.

5.4.3 Establishing the existing biodiversity value of habitats within the scheme boundary and the likely impacts arising from the scheme will inform the mitigation requirements to ensure biodiversity net gain post development. This will likely involve areas to compensate for the lost woodland, hedgerows and grassland, either within the area of works or through land purchase within the same district.

5.5 Potential mitigation measures

5.5.1 Loss of terrestrial GCN habitat is expected through loss of grassland, scrub, woodland and hedgerows (refer to Section 6.5 below). As GCN are known to be present within the northern area of the scheme, as identified within the ES for the Hardwick Green housing development, a European Protected Species Mitigation Licence (EPSML) will likely be required to preserve the favourable conservation status of this species.

5.5.2 It is unknown at this stage whether an EPSML and associated mitigation strategy will be required for a bat tree or building roost. This will be confirmed

following the ground level tree assessment and if required, aerial inspections and / or emergence re-entry surveys.

5.5.3 If a badger sett is identified within or immediately adjacent to areas proposed for construction, sett closure may be necessary. Licences for this activity can only be obtained from Natural England to undertake these activities between 1 July and 30 November.

5.5.4 Habitat loss and severance by the scheme will be considered to ensure that species commuting through the existing habitats are mitigated for.

5.5.5 All mitigation will follow current good practice guidelines. Wildlife sensitive lighting will be considered at the design stage to ensure there is minimal impact on species such as foraging bats during the construction and operational phase. Timings for habitat removal will be planned to avoid disturbance to species such as nesting birds during the breeding season and so ensuring compliance with the Wildlife and Countryside Act (1981, as amended).

5.5.6 All mitigation regarding habitat and species will be secured within a CEMP to ensure all specifications meet good practice guidelines.

5.6 Description of likely significant effects

5.6.1 The scheme may result in the following likely significant effects:

Site preparation and Construction Phase

Non-statutory designated sites

- It is anticipated that the scheme has the potential to impact on the adjacent Sheep's Course Wood CWS through an increase in lighting, noise and air pollution.

Habitats

- Direct loss of broad-leaved woodland, hedgerows, grassland, scrub; and
- Severance of habitat, reducing connectivity and pollution incidents.

Protected/notable species

- Amphibians – potential loss of breeding and terrestrial GCN habitat;
- Bats – loss of habitat, including severance. Potential impacts to tree roosts, foraging and commuting behaviour;
- Badger – potential impacts to sett building, foraging and commuting habitat;
- Birds – potential loss of breeding, wintering and foraging habitat;
- Otter and Water Vole – potential severance of ditches that may be used by water voles and otter;
- Reptiles – potential loss of habitat used for basking, foraging and sheltering reptiles;
- Invertebrates - potential loss of habitat for notable invertebrate species;
- Other species of Principal Importance (e.g. brown hare, hedgehog): loss of habitat, including severance; and
- Invasive species – if species listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) are identified within or connected to the scheme, there is the potential for these species to spread through improper management.

Operational Phase

Non-statutory designated sites

- Potential impacts on Sheep's Course Wood CWS through an increase in lighting, noise and air pollution.

Habitats

- Impacts through an increase in pollution arising from operation such as runoff into the ground water.

Protected/notable species

- Bats – Potential impacts on foraging / commuting behaviour through an increase in noise and lighting;
- Badger – Potential casualties through traffic collisions on the road; and
- Other species of principal importance - Potential casualties through traffic collisions on the road and disturbance through an increase in noise and lighting.

5.7 Enhancement measures

5.7.1 The creation of new habitat will correspond with enhancements for protected and/or notable species. This will involve the creation of new ponds, hedgerows, tree planting and scrub / wildflower mosaic habitat.

5.7.2 An enhancement scheme for installing artificial habitat will also be considered where suitable. This will involve the installation of bat and bird boxes, invertebrate hotels and hibernacula.

5.7.3 Green infrastructure will be considered where possible such as rain gardens and swales to control water runoff and increase biodiversity.

5.8 Proposed assessment methodology

5.8.1 Identified impacts will be assessed in accordance with guidance provided by The Chartered Institute for Ecological and Environmental Management ('CIEEM'): Guidelines for Ecological Impact Assessment in the UK (2018). The methodology used to assess the likely effects on ecology will be the same for the construction and operational two stages of the scheme and will take the following approach:

- Determine the importance of ecological features affected, through survey and/or research;
- Assess impacts potentially affecting important features;

- Characterise the impacts by describing their extent, magnitude, duration, reversibility, timing and frequency;
- Identify cumulative impacts;
- Identify significant effects of impacts in the absence of any mitigation;
- Incorporate measures to avoid and mitigate (reduce) these impacts;
- Assess the significance of any residual effects after mitigation;
- Identify appropriate compensation measures to offset significant residual effects (if any); and
- Identify opportunities for ecological enhancement.

5.8.2 CIEEM's approach to impact assessment has been adapted to classify the magnitude of impacts by a matrix approach to determine significance of effects. This is based on the DMRB approach used for road schemes in the UK (LA 104 Environmental assessment and monitoring).

Importance / sensitivity

5.8.3 Sensitivity is a means to measure how affected receptors/processes and/or the receiving environment is to change. The sensitivity is assigned at the receptor/process level. This may be defined in terms of quality, value, rarity or importance, and be classed as negligible, low, medium, or high.

5.8.4 Table 5.4 summarises the ecological feature conservation value and/or sensitivity adapted from CIEEM for habitats and species which has been adapted for use in this assessment. CIEEM use the term "Importance" to reflect value and sensitivity, and this term has been adopted here and represented at geographical scales. Common and widespread features that do not meet the criteria for local importance are considered to be of negligible importance and will not be assessed.

Table 5.4 – Description of geographical scales of ecological importance

Importance	Criteria
International (European)	Habitats: An internationally designated site or candidate site (SPA, provisional SPA, SAC, candidate SAC, Ramsar Site, Biogenetic/Biosphere Reserve, World Heritage Site) or an area that would meet the published selection criteria for designation. A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat, which are essential to maintain the viability of a larger whole. Species: Any regularly occurring population of internationally important species, threatened or rare in an international context (e.g. International Union for the Conservation of Nature Red Data Book species listed above 'Least Concern'). A regularly occurring species population which exceeds the threshold for national importance as sett by guidelines for designation of illogical SSSIs in the UK or similar guidance where available).
National (UK)	Habitats: A nationally designated site, SSSI, NNR, Marine Nature Reserve or a discrete area, which would meet the published selection criteria for national designation (e.g. SSSI selection guidelines). A large area of a Habitat of Principle Importance, Ancient Woodland or Wood Pasture and Parkland HPI. Species: Any regularly occurring/large population of a nationally important species (e.g. England Red Data Book). A large population of a species identified as a Species of Principal Importance. A species population which would qualify for SSSI designation.

Importance	Criteria
County (Norfolk)	Habitats: Sites recognised by local authorities, e.g. LWSs. County sites that the designating authority has determined meet the published ecological selection criteria for designation. A diverse and/or hedgerow network comprised of mostly Important Hedges. Degraded areas of HPI (excluding Wood Pasture and Parkland HPI and Ancient Woodland Lowland Mixed Deciduous Woodland HPI which is Ancient Woodland). Species: Any regularly occurring, locally significant population of a SPI or a species listed in a county/district BAP (where available). A regularly occurring, locally significant population of a county/district important species. Sites supporting populations of internationally/nationally/regionally important species that are not threatened or rare in the region or county, and not integral to maintaining those populations. Sites/features scarce in the county or that appreciably enrich the county habitat resource.
District (Kings Lynn Borough)	Habitats: Areas of habitat that appreciably enrich the local habitat resource (e.g. species-rich hedgerows, ponds). Sites that retain other elements of semi-natural vegetation that, due to their size, quality or the wider distribution within the local area, are not considered for the above classifications. Species: Populations/assemblages of species that appreciably enrich the biodiversity resource within the local context. Sites supporting populations of county/district important species that are not threatened or rare in the region or county and are not integral to maintaining those populations.
Local	Habitats: Areas of heavily modified or managed vegetation of low species diversity or low value as habitat to species of nature conservation interest. Species: A good example of a common or widespread species.

Magnitude

5.8.5 The magnitude relates to the level at which the receptor will be impacted, using the duration of the impact, timing, scale, size and frequency to determine the magnitude of the impact to each feature. Magnitude of impact is evaluated in accordance with the definitions set out in Table 5.5 below. The following characteristics will be used to assess the magnitude of the impact on ecological features as a result of the scheme:

- Type of impact – beneficial or adverse;
- Extent or spatial scope of the impact;
- Reversibility of impact – whether the impact is naturally reversible or reversible through mitigation measures;
- Timing and frequency of the impact, in relation to ecological changes; and
- Likely duration of the impact - short-term (< 1 year), medium-term (1 - 5 years) or long-term (5 or more years).

Table 5.5 – Definitions of impact magnitude on ecological features

Magnitude	Definition
High	Total loss or large alteration to key elements/features of the baseline (i.e. pre-development) conditions.
Medium	Partial loss or alteration to one or more key elements/features of the baseline (i.e. pre-development) conditions
Low	Small shift away from baseline (i.e. pre-development) conditions.
Negligible	Very slight change from baseline (i.e. pre-development) conditions.

Proposed significance criteria

5.8.6 The overall significance will be assessed using the matrix shown in Table 5.6. This uses sensitivity of the receptor and magnitude of change to determine significance. Where a range of significance of effect is presented in Table 5.6 the final assessment for each effect is based upon expert judgement. For the purposes of this assessment, any effects with a significance level of Moderate or above have been concluded to be significant.

Table 5.6 – Matrix to assess significance on ecological features

Value/importance	Magnitude of effect as High	Magnitude of effect as Medium	Magnitude of effect as Low	Magnitude of effect as Negligible
International	Major	Major to Moderate	Moderate	Negligible
National	Major	Major to Moderate	Moderate	Negligible
County	Major to Moderate	Moderate	Minor to Moderate	Negligible
District	Moderate	Minor to Moderate	Minor	Negligible
Local	Minor	Minor	Negligible	Negligible

5.9 Assessment assumptions and limitations

5.9.1 Updated Phase 1 Habitat and species-specific surveys are scheduled for 2021 in order to inform the ES.

5.9.2 Where possible collaboration will be made regarding any future mitigation and enhancement opportunities with respect to the West Winch Growth Area including the proposed Hardwick Green development.

5.10 Factors and elements scoped in and out of further assessment

Table 5.7 – Ecology elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Non-statutory designated sites	Construction and Operation	Yes	No	Sheep's Course Wood CWS lies partly within the Survey Area, potential loss of woodland. Operational effects due to increase of lighting, noise and air pollution
Habitats	Construction and Operation	Yes	No	Direct loss of woodland from construction and potential increase in pollution in operational phase.
Badger	Construction and Operation	Yes	No	Potential impacts on setts, foraging and commuting habitat. Potential for increased risk of strike from operational traffic.
Bats	Construction and Operation	Yes	No	Potential for loss of habitat and commuting severance.
Bird species	Construction	Yes	No	Potential loss of breeding and foraging habitat
Barn owl	Construction and Operation	No	No	Potential loss of breeding sites and foraging habitat. Potential for increased risk of strike from operational traffic
Amphibians	Construction	Yes	No	Potential loss of breeding and terrestrial GCN habitat.
Reptiles	Construction	Yes	No	Potential for loss of habitat and commuting severance.

Element	Phase	Scoped In	Scoped Out	Justification
Otter and water vole	Construction and Operation	Yes	No	Potential for loss of habitat and pollution and disturbance during operation.
Other SPI species (brown hare, hedgehog)	Construction and Operation	Yes	No	Potential for loss of habitat and commuting severance. Potential for increased risk of strike from operational traffic.
Invertebrates	Construction	Yes	No	Potential loss of habitat
Invasive Species	Construction	Yes	No	If species listed under Schedule 9 of the Wildlife and Countryside Act (1981) are identified within or connected to the scheme. There is the potential for this species to spread from the scheme through improper management.
Impacts on European / Ramsar sites (Habitats Regulation Assessment (noise).	Construction and Operation	No	Yes	The nearest site, Roydon Common Ramsar site, is located approximately 6.1km to the east of the scheme. Impacts to this site are not expected to arise from the scheme.

6 Landscape and visual

6.1 Study area

6.1.1 An initial 5km radius search area was considered to identify the key landscape and visual receptors. Through site assessment, taking into consideration landform, land use, landscape elements, landscape character, predicted visibility of the scheme within the landscape and an identification of

the nearest visual receptors it was considered a 2km radius study area would be appropriate to capture all potential significant landscape and visual effects. Figure 6.1 (refer to the *Viewpoint Location Plan*, Appendix E), illustrates the scheme location, the proposed landscape and visual impact assessment (LVIA) study area, and previously agreed viewpoint locations.

6.2 Consultation

Consultation undertaken to date

6.2.1 Consultation that has been undertaken to date is summarised below in Table 6-1.

Table 6.1 – Landscape and visual impact assessment consultation undertaken to date

Body / Organisation / Individual	Consultation subject and content	Summary of responses / outcomes of consultation
Kings Lynn and West Norfolk Borough Council: Planning Officer	Initial Viewpoint Location: List of proposed viewpoint locations with receptors and viewpoint location plan. Issued via email on 07/03/2019.	A number of responses received by email between 25/02/2019-21/03/2019 confirm that the council planning department were satisfied with the chosen viewpoints. The Planning Case Officer identified a PRoW to the north of the scheme as a viewpoint location which will be explored in summer photography. Also identified was a further viewpoint location to the south-east which has been included.

Proposed consultation

6.2.2 Consultation that needs to be undertaken for the assessment of landscape and visual impact are summarised in below Table 6-2.

Table 6.2 – Proposed consultation for the landscape and visual impact assessment

Body / Organisation / Individual	Consultation subject and content
BCKLWN: Planning Case Officer	Consultation via email/telephone to confirm agreement to the previously agreed landscape baseline and viewpoint selection.

6.3 Baseline conditions

Topography and vegetation

6.3.1 The landscape within and surrounding the scheme is generally flat with very gentle undulation. It lies approximately 10-20m Above Ordnance Datum (AOD). The low topography is due to the close proximity to the River Nar which is situated west and south of the scheme.

6.3.2 The scheme is located on predominantly greenfield agricultural land (Grade 2 and 3) with the exception of an area of scrubland where the scheme joins the A47. The agricultural fields are bound by hedgerows; however, some have suffered hedgerow loss and many boundaries are marked by rough grass and/or drainage ditches lined with reeds and rushes. Small areas of woodland copses and individual trees are featured in the landscape, generally close to small linear villages.

6.3.3 A number of infrastructure / industrial elements feature in the landscape including the A47 highway to the north and large-scale electricity pylons with overhead wires to the south.

6.3.4 There are no areas of ancient woodland within the site or within 2km of the scheme.

Cultural heritage assets

6.3.5 Refer to Section 4.3 of this report.

Public rights of way

6.3.6 There are no National Trails within 2km of the scheme. There is a designated recreational route, the Nar Valley Way, which runs alongside the River Nar and connects King's Lynn with Gressenhall, situated 1.3km south of the scheme. There are PRoW within close proximity to the scheme which are as follows:

- West Winch FP3;
- North Runcton FP1;
- North Runcton RB3; and
- North Runcton BR4.

6.3.7 There are numerous PRoW within 2km of the scheme which are as follows:

- Kings Lynn FP23;
- Kings Lynn FR25;
- Kings Lynn FP26;
- Kings Lynn FP27;
- Kings Lynn RB22;
- Kings Lynn RB24;
- Kings Lynn BR28;
- Kings Lynn RB30;
- Kings Lynn RB31;
- Kings Lynn RB39;
- North Runcton FP1;

- North Runcton RB2;
- North Runcton RB6;
- West Winch RB1;
- West Winch FP2;
- West Winch FP4;
- West Winch FP5 (along the Nar Valley Way);
- West Winch FP6;
- Wormegay FP4;
- Wormegay FP5; and
- Wormegay FP9.

6.3.8 National Cycle Network Route no.1 lies just within and beyond the east and north east of the study area, between Wisbech to Kings Lynn, approximately 1.9km from the scheme at closest. National Cycle Network Route 11 lies just outside the study area to the south, connecting with Route no.1 in the north to Downham Market in the south.

6.3.9 There are two areas of Access Land close to the scheme, including a linear section from North Runcton leading south to Setchey Common which is approximately 50m east of the scheme at the closest point in North Runcton. A second linear section of Access Land is from the Hardwick Interchange leading south along the western edge of West Winch to Setchey which is approximately 200m west of the scheme at the closest point, just north of Setchey.

Landscape designations

6.3.10 There are no Areas of Outstanding Natural Beauty (AONB), National Parks or Country Parks within 5km of the scheme.

Landscape character

6.3.11 The site is within National Character Area 76: North West Norfolk. South and west of the scheme is National Character Area 46 The Fens. The National Character Areas cover vast areas. At a more detailed level, BCKLWN published a Landscape Character Assessment for King's Lynn and West Norfolk (King's Lynn and West Norfolk Landscape Character Assessment by Chris Blandford Associates, published March 2007). The Landscape Character Assessment divides the borough into 11 Landscape Character Types (LCTs) and 61 Landscape Character Areas (LCAs).

6.3.12 The scheme is situated within two LCAs - G2: Middleton and G4: West Winch, which lie within the LCT - G: Farmland with Woodland and Wetland. LCA G1: Bawsey and Leziate, is located approximately 1.7km northeast of the scheme. Directly south of the scheme, is the boundary with LCA E2: Saddlebow and Wormegay which lies within LCT - E: The Fens – Open Inland Marshes.

Proposed baseline data collection

6.3.13 Review and update the determination of the landscape baseline context through:

- A desk-based review of relevant documents, including landscape/townscape character assessments, previous EIAs, relevant planning documents and relevant websites for Ordnance Survey (OS) mapping, aerial photographs and mapping to identify key landscape/townscape designations/receptors and policies;
- Consultation with BCKLWN via e-mail/telephone to confirm agreement to the previously included key landscape features/receptors of interest, concern or value;
- Site visit to confirm no significant changes to the local landscape character, local landscape components, value and condition since the last site visit; and

- Identification of the sensitivity of the landscape (i.e. its ability to accommodate change of the type proposed).

6.3.14 Review and update the determination of the visual baseline context through:

- A desk-based review of relevant documents, including landscape/townscape character assessments, previous EIAs, relevant planning documents and relevant websites for OS mapping, aerial photographs and mapping to identify key visual receptors;
- Production of a digital Zone of Theoretical Visibility (ZTV) to confirm the study area;
- Site visit to confirm no significant changes to the visual baseline and viewpoints;
- Consultation with BCKLWN via e-mail/telephone to confirm agreement with the previously agreed assessment viewpoints and number/type of views on the basis that there has been no significant changes to the visual baseline and the viewpoints still appropriately cover the scheme; and
- Identification of the sensitivity of the key visual receptors.

6.4 Mitigation measures

6.4.1 Any additional mitigation will be identified and confirmed depending on the significance of the effect, and a landscape mitigation plan developed as part of the scheme design to assist in the mitigation of any potential landscape and visual effects.

6.4.2 In summary, the following mitigation would be implemented during the construction phase of the works:

- Retention of existing established vegetation where appropriate;

- Within the construction compounds, temporary soil mounds would be utilised to screen views of construction activities and light pollution within the surrounding area;
- The construction programme would be kept to the minimum practicable time to reduce the duration of any landscape and visual impacts. Areas would be cleared for construction as close as possible to works commencing and top soiling, reseeding and planting would be undertaken as soon as practicable after sections of work are complete;
- As far as practicable, plant and material storage areas would be appropriately sited to minimise their landscape and visual impact;
- Construction sites would be kept tidy (e.g. free of litter and debris);
- Work during the hours of darkness would be avoided as far as practicable and where necessary directed lighting would be used to minimise light pollution/glare; and
- Lighting levels would be kept to a minimum necessary for security and safety.

6.4.3 To protect soil quality for the purposes of landscape planting, the following measures would be implemented:

- Uncontaminated topsoil for re-use would be stored in un-compacted mounds no more than 2m in height and stored separately from subsoil material;
- Stripped topsoil would be used in areas of the same proposed vegetation type to utilise the existing natural seed bank;
- Subsoil in planting areas would be replaced after construction and ripped to a minimum depth of 450mm before top soiling and planting;
- Construction activities would be managed such that the loss of any existing woodland, scrub, heath, grassland vegetation, and isolated

trees and shrubs not affected by the permanent works is limited as far as practicable; and

- All existing trees and shrubs not affected by the construction of the permanent works would be fenced off with a suitable type of temporary fencing in accordance with British Standard (BS) 5837. Fencing would extend to the drip line of the tree canopies (unless otherwise agreed by an arboriculture advisor). Fencing would be erected before any construction activities in that area and would remain for the entire phase of construction in that area.

6.5 Description of likely significant effects

6.5.1 Potentially significant effects will be assessed for both the construction phase and operational phases of the scheme.

6.5.2 Site preparation, earthworks and construction may significantly affect the local landscape character, the quality of local PRoW, and the setting and quality of public open space (Open Access Land). Effects may be direct as well as indirect, and both temporary and permanent. Construction effects are likely to be greater than at operation due to uncharacteristic plant, materials and construction activities.

Construction

6.5.3 The following potentially significant effects will be considered for the construction phase:

- Effects on the topography of the site;
- Effects on the quantity of trees and hedgerows within the site;
- Effects on the local landscape character of the site and within immediate surroundings; and
- Effects on the views available to surrounding residents, users of highways and PRoW users.

Operation

6.5.4 The operational scheme may significantly affect the local landscape character, the character of the scheme and immediate local area, including growth of any new tree and vegetation planting as part of the mitigation planting proposals. This may also affect the local visual amenity from surrounding PRoW and surrounding residences or highway users. Effects may be direct as well as indirect and are likely to be permanent at operation.

6.5.5 The following potentially significant effects will be considered for the operational phase:

- Effects on the local landscape character of the site and its surroundings; and
- Effects on views available to surrounding residents, users of highways and PRoW users.

6.6 Enhancement measures

6.6.1 No specific enhancement measures are anticipated for the construction phase. However, through the assessment process, enhancement measures would be identified, with potential to create new woodland and hedgerow planting to integrate the scheme within the landscape and surrounding woodlands and adjacent residential developments brought forward as part of the West Winch Growth Area, and to reinforce and enhance the local landscape character and improve green infrastructure, interconnectivity and biodiversity.

6.7 Proposed assessment methodology

6.7.1 The assessment of landscape and visual effects are separate, but linked, procedures. In terms of landscape effects, Highway England's DMRB's LA107 (Design Manual for Roads and Bridges, Sustainability & Environment Appraisal, LA 107 Landscape and visual effects, Revision 2, (2020)) notes that, 'the landscape is considered as an environmental resource' and references the Guidelines for Landscape and Visual Impact Assessment

(GLVIA3) (Guidelines for Landscape and Visual Impact Assessment (Third Edition) (GLVIA3), published by the Landscape Institute and the IEMA (2013)), paragraph 2.14, which states that landscape effects are derived 'from changes in the physical landscape, which may give rise to changes in its character and how this is experienced. This may in turn affect the perceived value ascribed to the landscape'.

6.7.2 In contrast, visual effects 'relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity' (GLVIA paragraph 2.15). Visual assessments should therefore describe key potential visual locations and receptors which may experience a change in the existing view as a result of the scheme.

6.7.3 The LVIA will collate existing information on local landscape character and visual receptors within and surrounding the scheme and determine their sensitivity. This sensitivity will be derived from their value and the susceptibility to the type of development proposed and identified on a scale from Negligible to Very High.

6.7.4 An assessment will then be made of the magnitude and nature of potential effects of the scheme upon the key identified landscape and visual receptors and will identify appropriate mitigation measures, where applicable. The magnitude of effect judgement considers scale, extent and duration of effect and considered on a scale from No Change to Major. The nature of effect can be beneficial, adverse or neutral. Both landscape and visual effects will be considered at operation and construction stages.

6.7.5 The following guidance documents will be used during the preparation of the LVIA:

- Highways England's Design Manual for Roads and Bridges, Sustainability & Environment Appraisal, LA107 Landscape and visual effects, Revision 2 (2020);

- GLVIA3, published by the Landscape Institute and the Institute of Environmental Management and Assessment (2013); and
- Natural England's, An Approach to Landscape Character Assessment (October 2014).

6.7.6 The methodology will be primarily informed by the guidance provided in LA107, supported and updated as appropriate by GLVIA3, such as where the latter places greater emphasis on professional judgement in the explanation and justification for assessment criteria and conclusions, appropriate to the scheme being assessed.

6.7.7 Where required, and where they will inform the assessment, accompanying photography will be presented following guidance as outlined within industry best practice guidance including the Landscape Institute's, Technical Guidance Note 06/19 Visual Representation of Development Proposals (September 2019).

6.7.8 It is considered that given the proximity of some PRoW, Countryside Rights of Way (CRoW), Open Access Land, and residential receptors, and that the present landscape is in good condition, that there is the potential for significant effects and a full LVIA is required.

Proposed viewpoints

6.7.9 The total number of viewpoints proposed for the LVIA is 13, as set out in Table 6.3 below.

6.7.10 The list below was agreed in consultation with BCKLWN in March 2019, and summer and winter viewpoint photography were undertaken in March and September 2019. These viewpoints have been reviewed with regard to the scheme changes and it is considered that they are still relevant to appropriately cover the scheme extents and aid the visual assessment. It is not proposed to change or add to this viewpoint list. A site visit will be undertaken to confirm that the baseline photography already taken for the viewpoints is still valid, with no significant changes in the views.

Table 6.3 – Proposed LVIA viewpoints

Number	Viewpoint	Reason for Selection	Reference
1	Nar Valley Way, Setchey	Viewpoint to illustrate site context, landscape character and views from a regionally promoted recreational route. It is representative of views available for local recreational receptors along the Nar Valley Way, following the River Nar, south of the scheme. Viewpoint facing due north.	E563929, N313327
2	A10, Setchey	Viewpoint to illustrate site context, landscape character and views from the local road network and residential properties north of Setchey on the A10. It is representative of views available for local residential and road receptors along the A10, south west of the scheme. Viewpoint facing north east.	E563485, N314245
3	A10, West Winch at junction with Gravelhill Lane	Viewpoint to illustrate site context, landscape character and views from the local road network and residential properties at the junction of the A10 and Gravelhill Lane, West Winch. It is representative of views available for local residential and road receptors along the A10, west of the scheme. Viewpoint facing north east.	E563442, N314895
4	A10, West Winch at junction with Chequers Lane	Viewpoint to illustrate site context, landscape character and views from the local road network and residential properties at the junction of the A10 and Chequers Lane, West Winch. It is representative of views available for local residential and road receptors along the Chequers Lane near the junction with the A10, west of the scheme. Viewpoint facing east.	E563312, N315600

Number	Viewpoint	Reason for Selection	Reference
5	Chequers Lane, North Runcton	Viewpoint to illustrate site context, landscape character and views from the local road network and residential properties on Chequers Lane, North Runcton. It is representative of views available for local residential and road receptors along the A10, east of the scheme, and also recreational users of a local PRoW & North Runcton Common. Viewpoint facing west.	E563943, N315611
6	PRoW between North Runcton and Setch Road	Viewpoint to illustrate site context, landscape character and views from the local PRoW network located halfway between North Runcton and Setch Road. The viewpoint is representative of the views available for local recreational receptors east of the scheme (21m AOD – as identified on the OS Map). Viewpoint facing west – north west.	E564718, N315319
7	Rectory Lane (west) Brook Farm	Viewpoint to illustrate site context, landscape character and views from the local road network and residential properties on Rectory Lane, east of West Winch. It is representative of views available for local residential and road receptors west of the scheme. Viewpoint facing east.	E563713, N316147
8	Rectory Lane (east)	Viewpoint to illustrate site context, landscape character and views from the local road network residential properties on Rectory Lane on western edge of North Runcton, on a local PRoW. It is representative of views available for local residential, recreational and road receptors east of the scheme. Viewpoint facing west.	E564027, N316157

Number	Viewpoint	Reason for Selection	Reference
9	A47 (east) at junction with New Road, North Runcton	Viewpoint to illustrate site context, landscape character and views from the local road network east of the scheme. It is representative of views available for local road receptors, east of the scheme, and those recreational visitors to the nearby caravan park. Viewpoint facing north west.	E564585, N316546
10	A47 (north) Constitution Hill	Viewpoint to illustrate site context, landscape character and views from the local road network north east of the scheme. Viewpoint is located within a safe parking area on this busy A trunk road. It is representative of views available for road receptors, north of the scheme. Viewpoint facing south – south east and north -northwest.	E563753, N317646
11	A149 (north)	Viewpoint to illustrate site context, landscape character and views from the local road network north of the scheme. Viewpoint is located within a safe parking area on this busy A trunk road. It is representative of views available for road receptors, north of the scheme. Viewpoint facing south west.	E563813, N318611
12	A10 West Winch at junction with Babingley Place (west)	Viewpoint to illustrate site context, landscape character and views from the local road network and residential properties on Bablingley Place. It is representative of views available for local residential and road receptors, west of the scheme. Viewpoint facing south east.	E563203, N317318

Number	Viewpoint	Reason for Selection	Reference
13	Setch Road	Viewpoint to illustrate site context, landscape character and views from the local road network from Setch Road. It is representative of the views available for local road receptors. Viewpoint facing west to north.	E563933, N314420

Proposed significance criteria

6.7.11 The significance of effect is determined by combining the sensitivity of the landscape or visual receptor and the magnitude of change judgement. Significance of effects will be assessed ranging from Negligible to Major and include the nature of effect as neutral, beneficial or adverse.

6.8 Assessment assumptions and limitations

6.8.1 The following assumptions have been made:

- In accordance with guidance two basic assumptions have been made:
  - The observer eye height will be assessed at 1.5m; and
  - The visual intrusion of traffic on the road will be assessed at an assumed maximum height of 4.5m, also taking into account the elevated sections of the northern sections of the road.
- The assessment of residual effects at year 15, following the opening of the scheme, will take account of the establishment of trees and shrubs planted as an integral component of the scheme;
- The assessment will assume that any planting would, by year 15, have achieved a minimum height of 4.5m. This assumption is based on predicted growth rates of 0.3m per annum which given the application of appropriate planting and management techniques, is considered to be a conservative estimated height. This predicted growth rate is also based on experience from comparable highway schemes. The

screening effect of vegetation would be less effective in winter in comparison to the summer months;

- Where PRoWs are being severed by the scheme, it is assumed that the PRoW will be closed for the duration of the construction phase, until such time as any diversion can be opened in its place; and
- For the purposes of assessing construction stage effects, temporary stockpiles of topsoil will be stored to a maximum height of 2m, stacked no closer than canopy spread of boundary vegetation i.e. out with the tree canopy areas. The soil within the storage areas would be stripped and stored for re-use and restored to the previous land use following the works.

6.8.2 The following limitations have been identified:

- Viewpoints are from publicly accessible locations only. Therefore, when establishing the views from dwellings and / or buildings, this will be based on information from a combination of desk-top studies, site work and professional judgement; and
- The ZTV will not take into consideration the screening / filtering of views posed by such intervening structures such as buildings, trees and hedgerows, and will not take into consideration the orientation of the viewer i.e. when travelling in a vehicle.

6.8.3 There are a number of areas within the ZTV where there are potential views of the scheme, but which comprise land to which the general public does not have access.

6.9 Factors and elements scoped in and out of further assessment

Table 6.4 – Landscape and visual elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Landscape Features	Construction and Operation	Yes	No	The scheme will result in the removal and disturbance of groundcover, trees and woodland.
Landscape Character	Construction and Operation	Yes	No	The scheme has potential to significantly alter the landscape character of the site and surroundings from existing farmland to one that includes infrastructure.
Visual Amenity	Construction and Operation	Yes	No	The scheme has the potential to significantly affect the visual amenity of receptors within and surrounding the site by introducing new infrastructure into farmland.
Townscape Assessment	Construction and Operation	No	Yes	Predicted neutral impact, based on the scheme's positioning east of the settlement of West Winch, visually screened by the built environment and tree and hedgerow cover.

7 Noise and vibration

7.1 Study area

7.1.1 The study area for construction noise, construction vibration and operational road traffic noise will be determined following the principles detailed in the Design Manual for Roads and Bridges (DMRB) Sustainability & Environment Appraisal LA 111 Noise and Vibration Revision 2 dated May 2020.

7.1.2 Operational vibration has been scoped out in accordance with the guidance in LA 111. Please refer to Table 7.10 for further information.

7.1.3 The respective study areas for each assessment element will comprise noise and vibration sensitive receptors that are potentially affected by noise and vibration changes generated by the scheme.

Construction noise

7.1.4 LA 111 indicates that a study area of 300m from the closest construction activity is normally sufficient to encompass noise sensitive receptors, and this is expected to be the case for this scheme. Furthermore, British Standard 5228-1(BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites - part 1 noise) states that at distances beyond 300m, other factors, such as meteorological conditions, have increasing influence and construction noise level predictions are considered less robust.

Construction vibration

7.1.5 LA 111 indicates that a study area of 100m from the closest construction activity with the potential to generate vibration is normally sufficient to encompass vibration sensitive receptors, and this is expected to be the case for this scheme.

Operational noise

7.1.6 In accordance with the guidance in LA 111, the following operational noise study area is expected to be appropriate for this scheme:

- the area within 600m of new road links or road links physically changed or bypassed by the scheme;
- the area within 50m of other road links with potential to experience a short term Basic Noise Level (BNL) change of more than 1.0dB(A) as a result of the scheme.

7.1.7 The new road links or road links physically changed or bypassed, which will therefore be subject to the 600m buffer, are expected to comprise:

- WWHAR between the A10 and A47;
- A47 (which will be dualled as part of the scheme) between the new A47 roundabout and the Hardwick Interchange;
- The Hardwick Interchange;
- A10 between the Hardwick Interchange and the new roundabout at the southern end of the scheme;
- Chequers Lane between West Winch and North Runcton (due to be closed to through traffic and a new bridge for non-motorised users installed over the WWHAR);
- Rectory Lane between West Winch and North Runcton (a new vehicular bridge is proposed over the WWHAR); and
- New Road and Common Lane in North Runcton as possible bypassed routes.

7.1.8 The precise study area for the wider road links (second bullet point of paragraph 7.1.6) is dependent on the traffic data which are not currently available; however it will be ensured that the study area selected is proportionate to the risk of the likely significant effects.

7.2 Consultation

Consultation undertaken to date

7.2.1 Consultation has been undertaken with the Environmental Health department at BCKLWN in May 2019. The methodology for establishing the baseline noise climate, including the noise measurement positions, has been agreed. The proposed methodology for assessing the noise and vibration effects of the scheme has also been agreed. Although this was based on the now superseded DMRB methodology (HD 213/11), many of the general principles of assessment remain consistent between the old and new DMRB guidance.

7.2.2 The following comments were received from the Environmental Health department at BCKLWN in the scoping response received following the submission of the original scoping report in June 2019. These comments have been taken into account in this revised scoping report:

- "Justification for 'stepping away' from DMRB HD 213/11".
- This is no longer relevant given the replacement of HD 213/11 with LA 111.
- "Ensure that the noise survey points are located near to sensitive receptors and that the surveys are carried out for the full 24hrs over the 3-day period."
- Please refer to section 7.3 which confirms this has taken place.
- "Need to see the methodology used to make the correction from $L_{A10,18h}$ at the façade to the free field L_{Aeq16h}."
    - The relationship between the $L_{A10,18h}$ and L_{Aeq16h} is considered less relevant now for operational noise that the daytime LOAEL (Lowest Observed Adverse Effect Level – refer to assessment methodology for further information) and SOAEL (Significant Observed Adverse Effect Level – refer to assessment methodology for further information) in LA 111 is expressed in

terms of a $L_{A10,18h}$ value. However, the relationship between the $L_{A10,18h}$ and $L_{Aeq,8h}$ or L_{night} is acknowledged as important given the night-time LOAEL and SOAEL are expressed in terms of $L_{night, outside}$. The relationship is expected to be determined using Method 3 of the Transport Research Laboratory (TRL) Project Report PR/SE/451/02 (TRL Limited Project Report PR/SE/451/02 (2002) Converting the UK traffic noise index LA10,18h to EU noise indices for noise mapping, Defra), and validated by differentials quantified from the noise survey data.

Proposed consultation

7.2.3 It is anticipated that this updated scoping chapter will form the basis for agreeing a revised assessment methodology which follows the principles of LA 111.

7.3 Baseline conditions

Baseline data collected to date

7.3.1 A baseline noise survey was completed in June 2019 at four measurement positions (MPs) (refer to Figure 7.1) in the vicinity of key sensitive receptors. Unattended measurements were completed at each position for a period of between 4 and 6 days.

7.3.2 The purpose of the measurements is to quantify the baseline noise climate in the vicinity of key receptors, to facilitate the validation of the 3D noise model. In particular the data will be used to compare the modelled noise levels based on supplied traffic data with noise levels measured in-situ. The data may also be used to assist with establishing the site-specific relationship between noise metrics including the $L_{A10,18h}$ and $L_{Aeq,8h}$.

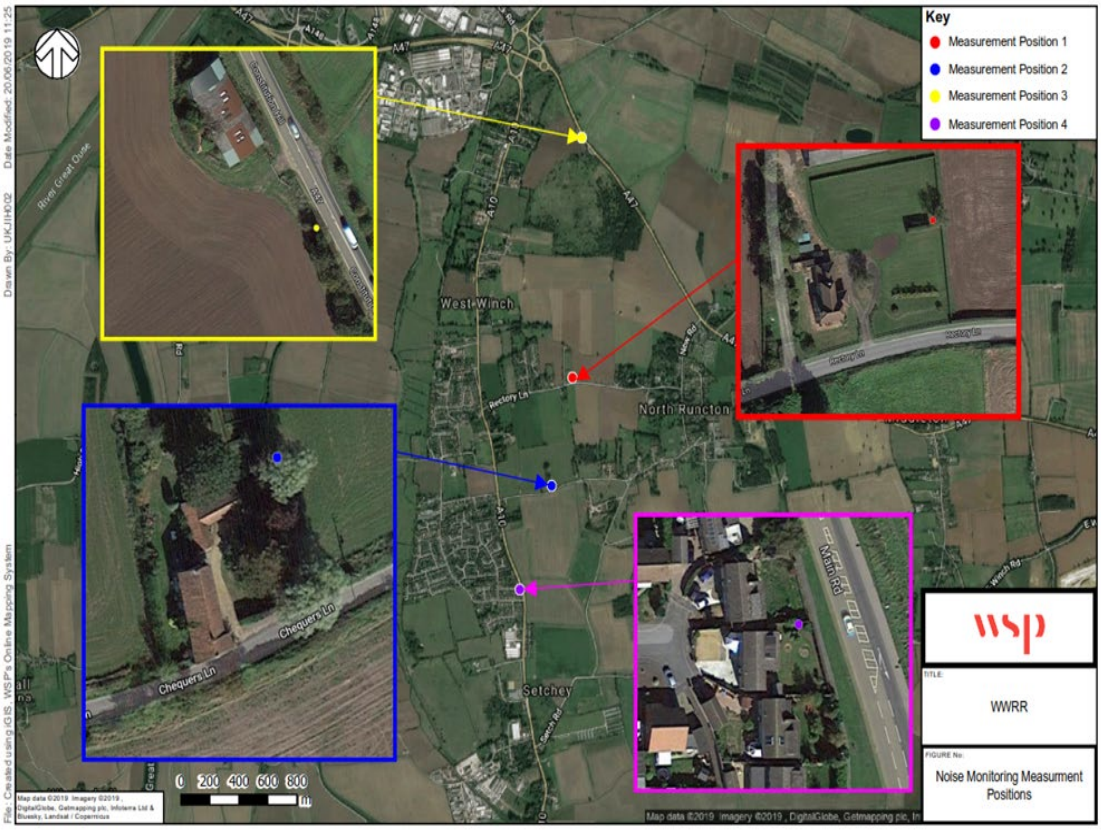

Figure 7.1 – Plan showing baseline noise survey measurement positions

7.3.3 Based on the survey data, the noise climate across the study area varies spatially and temporally. Areas located close to the A47 (MP3), A10 (MP4) and Hardwick Interchange are dominated by road traffic noise. However, the study area also includes areas that are more distant from main roads (MP 1 and 2) and as such, are subject to lower ambient noise levels.

Noise sensitive receptors

7.3.4 Examples of receptors which are potentially sensitive to noise and vibration include dwellings, hospitals, healthcare facilities, education facilities, community facilities, Environmental Noise Directive (END) quiet areas, international and national or statutorily designated sites, public rights of way, cultural heritage assets and buildings containing vibration sensitive equipment.

7.3.5 The residential receptors most likely to be affected by the scheme are presented below.

Residential receptors located closest to the scheme

- Dwellings on the A10 approximately 20m south east of the new junction with the scheme;
- Dwellings on the section of the A47 Constitution Hill which is proposed to be dualled*;
- Dwelling on Chequers Lane to the west of the scheme boundary;
- Dwellings on Rectory Lane to the east of the scheme boundary;
- Dwellings on Rectory Lane to the west of the scheme boundary;
- Dwellings accessed from Chequers Lane approximately 85m east of the scheme boundary.

*N.B. These dwellings are likely to be demolished to facilitate the dualling of the A47.

7.3.6 The dwellings listed at numbers 1-2 are subject to relatively high existing noise levels due to their close proximity to the A10 and A47, whereas the dwellings at numbers 3-6 are located further from main roads and therefore will be quieter.

7.3.7 There are also several non-residential noise sensitive receptors likely to be located within the study area, which are listed in Table 7.1.

Table 7.1 – Other sensitive receptors located in the likely study area

Receptor category	Name
School	West Winch Primary School, West Winch
School	Buttercups Pre-School, North Runcton
Community facility	St Mary's Church, West Winch
Community facility	William Burt Social Club, West Winch
Community facility	All Saints Church, North Runcton
Community facility	North Runcton Cricket Club
Community facility	Scout Hut on Chequers Lane, North Runcton

Noise important areas

7.3.8 The current Noise Action Plan for major roads outlines Noise Action Planning Important Areas (NIAs) at round three of the UK noise mapping project (published in July 2019), identified in accordance with the requirements of the EU Environmental Noise Directive (Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise - Declaration by the Commission in the Conciliation Committee on the Directive relating to the assessment and management of environmental noise), as transposed into UK law through the Environmental Noise Regulations 2006 (The Environmental Noise (England) Regulations 2006). The current NIAs (identified in rounds 1 to 3) located within or near to the likely study area are set out in Table 7.2.

Table 7.2 – NIAs located within or close to study area

NIA ID	Relevant noise source	Owner
5187	A10 West Winch Road	Norfolk County Council
11358	A10 Main Road	Norfolk County Council
5189	A10 Main Road	Norfolk County Council
14279	A10 Main Road	Norfolk County Council
5190	A10 Main Road	Norfolk County Council
5191	A10 Main Road	Norfolk County Council
11359	A10 Main Road	Norfolk County Council

7.4 Mitigation measures

Construction

7.4.1 Two types of construction noise and vibration mitigation may be recommended where required:

- Best practice noise mitigation techniques including:
  - Training of site personnel;
  - Effective community liaison; and

- Best Practicable Means (BPM) as defined in the Control of Pollution Act 1974.

- Specific mitigation measures to reduce noise and/or vibration impacts, including:

  - Specific construction methodologies or equipment which reduce noise and/or vibration;
  - Temporary barriers to provide noise screening;
  - Restricting certain activities to less sensitive time periods; and
  - Noise insulation or temporary rehousing.

7.4.2 Best practice mitigation to control noise and vibration from construction works and plant during the construction phase will be set out in the scheme CEMP and implemented by the contractors undertaking the works.

Operation

7.4.3 Based on the information currently available, it is not possible to identify the specific type and location of mitigation measures that may be appropriate for the operation of the scheme. However, noise mitigation options will be considered at all locations where significant effects are identified. The most likely noise mitigation measures could comprise noise barriers, earth bunding, low noise surfacing or speed limits. Noise mitigation measures will be assessed using a holistic and multi-disciplinary approach in collaboration with other disciplines (e.g. biodiversity and landscape). The viability of potential noise mitigation options will consider the number of properties affected by any such mitigation, the magnitude of the sound reduction, and the wider implications for other disciplines.

7.5 Description of likely significant effects

Construction

7.5.1 The level of construction noise/vibration and its effect on surrounding sensitive receptors will vary during the construction period, due to the varying

nature, locations and timescales of the activities taking place. Given the relatively close proximity of certain sensitive receptors to the scheme, the potential for some temporary high levels of noise and vibration cannot be discounted.

7.5.2 The key activities resulting in construction noise and vibration are anticipated to include:

- Excavation and earth profiling activities;
- The construction of the scheme and widening of the A47;
- Ground-breaking and resurfacing activities during the tying in of new roads into existing roads;
- Realignment and resurfacing activities during the Hardwick Interchange improvements and A10 traffic calming measures; and
- Deliveries of plant and materials.

7.5.3 Given the nature of the scheme, the majority of the construction works will be linear in nature, whereby the associated construction activities will be transient along the alignment of the scheme. Therefore, activities are unlikely to be taking place in a single location for a prolonged period of time.

7.5.4 However, possible exceptions to this assumption are as follows:

- The tying in of the scheme to the A10, where sensitive receptors are located close to potential construction works. There is the potential for significant noise and vibration effects at these receptors;
- The dwellings located closest to the scheme on Chequers Lane and Rectory Lane could be subject to significant noise and vibration effects during any earthworks and during road construction activities; and
- The Hardwick Interchange improvements will not be transient and instead will be focused in the immediate vicinity of the interchange. Whilst high noise levels may be generated at the construction works

site, given the nearest sensitive residential receptors to the Hardwick Interchange are located approximately 100m away, the potential for significant effects at these receptors is considered to be unlikely.

Operation

7.5.5 The scheme has the potential to produce both beneficial and adverse significant noise effects during the operational stage. The extent of operational effects will be dependent on both the change in noise level and the absolute noise level at a sensitive receptor.

7.5.6 Significant effects are most likely to occur in the following instances:

- Significant adverse effects may occur at the sensitive receptors located close to the scheme. In the more rural areas (near Chequers Lane and Rectory Lane), where road traffic is not currently a dominant noise source, the increase in noise level from traffic using the scheme may be significant;
- Significant adverse effects may occur at sensitive receptors located close to the junction of the scheme with the A10, as a result of higher traffic flows using the new junction. There is the potential for significant adverse effects at sensitive receptors at this location as a result of an increase in noise and given the existing noise level in this area is already high (potentially above the SOAEL);
- There is potential for significant beneficial effects as a result of traffic redistribution from the scheme, whereby traffic is diverted from existing roads, particularly for the sensitive receptors on the A10 between the Hardwick Interchange and the scheme / A10 junction;
- This is potential for significant beneficial effects as a result of possible traffic speed reductions (and therefore noise level reductions) as a result of the scheme, including the proposed traffic calming measures on the A10; and

- There is the potential for significant beneficial effects for receptors in North Runcton due to the closure of Chequers Lane to motorised traffic at the point the road passes over the WWHAR.

7.6 Enhancement measures

7.6.1 The Noise Policy Statement for England (NPSE) (Noise Policy Statement for England. March 2010. DEFRA: London.) states that, where possible, the control of noise should look to contribute to the improvement of health and quality of life, within the context of government policy on sustainable development. At this stage of the assessment, it is not possible to identify the type and location of possible enhancement measures; however possible enhancement measures could include noise barriers, earth bunding or low noise surfacing. During the noise assessment, the viability of potential enhancement options will be assessed within the context of government policy on sustainable development.

7.7 Proposed assessment methodology

7.7.1 The noise and vibration assessment will be guided by the principles of DMRB LA 111.

Construction

7.7.2 A preliminary assessment of temporary construction noise and vibration impacts will be undertaken in accordance with LA 111, which itself draws on the guidance contained in BS 5228:2009+A1:2014 (BS 5228:2009+A1:2014 . Code of practice for noise and vibration control on construction and open sites – Part 1 Noise and BS 5228:2009+A1:2014 . Code of practice for noise and vibration control on construction and open sites – Part 2 Vibration).

7.7.3 The scope and level of detail of the assessment undertaken will be proportionate to the risk of a likely significant effect occurring.

Construction noise

7.7.4 The baseline noise environment for the construction assessment will be quantified by a combination of noise measurement survey data and predicted noise levels based on noise modelling.

7.7.5 Construction noise levels at the façade of the nearest sensitive receptors to each area of works will be estimated quantitatively based on the likely plant items (type, quantity and location), construction activities and proposed construction programme, for the daytime, evening and night-time periods, as appropriate. A degree of professional judgement will be required to pragmatically group sensitive receptors and activities where appropriate.

7.7.6 The construction assessment will also include the potential noise and vibration impacts associated with the gas main diversion works.

Defining LOAELs and SOAELs

7.7.7 The terms LOAEL and SOAEL are taken from national noise policy, most notably the NPSE.

- LOAEL – the level above which adverse effects on health and quality of life can be detected.
- SOAEL – This is the level above which significant adverse effects on health and quality of life occur.

7.7.8 The magnitude and significance of effects for construction noise will be determined by comparing predicted construction noise levels with the defined LOAEL and SOAEL values. The methodology for defining values for LOAEL and SOAEL is explained in the next paragraph, and the methodology for determining the magnitude and significance of effect is presented from paragraph 7.7.24.

7.7.9 LOAELs and SOAELs will be defined in accordance with the guidance in Table 3.12 of LA 111. The LOAEL for each time period (day, evening/ weekends and night) will be set as the baseline noise level for each receptor or group of receptors. The SOAEL will be set as the threshold level

determined using section E.3.2 and Table E.1 of BS 5228-1 (the ABC method), which is replicated in Table 7.3.

Table 7.3 – Construction noise – BS 5228-1 – threshold of potential significant effects at the façade of dwellings – used to determine the SOAEL

Assessment category and threshold value period	**Threshold value, in decibels (dB, $L_{Aeq,T}$) as Cat. A A)**	**Threshold value, in decibels (dB, $L_{Aeq,T}$) as Cat. B B)**	**Threshold value, in decibels (dB, $L_{Aeq,T}$) as Cat. C C)**
Night-time (23:00 −07:00)	45	50	55
Evenings and weekends D)	55	60	65
Daytime (07:00 −19:00) and Saturdays (07:00−13:00)	65	70	75

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

D) 19:00–23:00 weekdays, 13:00–23:00 Saturdays and 07:00–23:00 Sundays.

NOTE 1 - A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

NOTE 2 - If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.

NOTE 3 - Applied to residential receptors only.

Construction vibration

7.7.10 The construction vibration baseline will be assumed to be zero in the absence of significant vibration sources prior to the construction of the scheme.

7.7.11 BS 5228-2 provides guidance for the assessment of significance of construction vibration effects. The effects can be classified based on both human response to vibration and the structural effects to buildings, but the threshold levels for building damage are far higher than for human response. It is considered very unlikely any vibration levels would be sufficiently high to result in building damage, and therefore only human response to vibration effects will be considered, which will be in in terms of the Peak Particle Velocity (PPV) levels.

Defining LOAELs and SOAELs

7.7.12 The magnitude and significance of effects for construction vibration will be determined by comparing predicted construction vibration levels with the defined LOAEL and SOAEL values. The defined values for LOAEL and SOAEL are explained in the next paragraph, and the methodology for determining the magnitude and significance of effect is presented from paragraph7.727.

7.7.13 LOAELs and SOAELs will be defined in accordance with the guidance in Table 3.31 of LA 111:

- The LOAEL will be set as 0.3 mm/s PPV, described in BS 5228-2 as vibration that ‘might just be perceptible in residential environments’.
- The SOAEL will be set as 1.0 mm/s PPV, described in BS 5228-2 as vibration that ‘in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.’

Operational noise

7.7.14 A 3D digital noise model of the scheme and existing highway network will be created using CadnaA noise modelling software to predict the levels of road

traffic noise at the existing noise sensitive receptors within the study area. The spatial extent of the noise model will encompass the study area, as well as a surrounding area sufficient in size to ensure that robust noise predictions can be undertaken.

7.7.15 Road traffic noise predictions within the noise model will be undertaken in accordance with the Calculation of Road Traffic Noise (CRTN) (Department of Transport (1988) Calculation of Road Traffic Noise, HMSO:London.) and following any additional procedures/ modifications defined in DMRB LA 111.

7.7.16 It will not be possible to follow the LA 111 modification to use pivoted traffic speeds in the noise modelling. The traffic modellers have confirmed that speed pivoting is not a possibility due to nature of the journey time data received from NCC. However, this is not considered to be a concern for the robustness of the assessment because the traffic modellers have confirmed that the modelled journey times around the study area validate very well to observed journey times. Furthermore, the levels generated by the noise model will be validated with the measured noise levels to ensure the two are comparable. Section of 2.4.1 of DMRB GG 101 *Introduction to the Design Manual for Roads and Bridges* suggests that departures from the standard methodology can occur for local authority road schemes where it can be justified and subject to approval by the Overseeing Organisation (i.e. NCC).

7.7.17 Night-time noise levels will be derived from the daytime noise predictions, using an appropriate methodology, such as Method 3 of the Transport Research Laboratory (TRL) Project Report PR/SE/451/02, and validated by the day-night noise differential identified from the noise survey data.

7.7.18 As required by DMRB LA 111, the daytime and night-time noise change due to the scheme will be determined at noise sensitive receptors within the study area for the following scenarios:

- Short term noise change: Do Minimum Opening Year (DMOY) compared against the Do Something Opening Year (DSOY);

- Long-term noise change: DMOY compared against the Do Something Future Year (DSFY);
- Non-project long-term noise change: Do Minimum Future Year (DMFY) compared against the DMOY.

7.7.19 In additional to the three LA 111 scenarios, a long-term cumulative scenario will also be assessed. This will compare the DMOY against the 'Do Something Future Year (DSFY) Cumulative'. The DSFY Cumulative will use traffic data for the future design year with the scheme and the up to 4000 future dwellings as proposed within the West Winch Growth Area. This DSFY Cumulative will utilise traffic data which will include the impact of these associated residential schemes on the surrounding road network, which will enable an assessment of cumulative noise effects at existing sensitive receptors.

7.7.20 Where the noise sensitive receptor is a building, the façade used to calculate noise change will be based on the façade with the greatest magnitude of noise change. Further detail on the methodology is contained in LA 111.

7.7.21 The assessment of these scenarios will enable the completion of the summary tables 3.55 a and b contained within DMRB LA 111, which present the daytime and night-time change in noise level in the short-term and long-term at sensitive receptors within the study area.

Defining LOAELs and SOAELs

7.7.22 LOAELs and SOAELs for operational noise, which are a method for categorising the absolute level of noise from a scheme, will be used as one of the contextual factors in determining the significance of effect at receptors. The values are set in the paragraph below and the methodology for applying them is explained in paragraph7.7.32.

7.7.23 LOAELs and SOAELs will be set for all noise sensitive receptors within the study area. The LOAELs and SOAELs will be based on the values in LA 111, which are replicated in Table 7.5.

Table 7.2 – Operational noise LOAELs and SOAELs

Time Period	LOAEL	SOAEL
Day (06:00-24:00)	55dB $L_{A10,18h}$ façade	68dB $L_{A10,18h}$ façade
Night (23:00-07:00)	40dB $L_{night,\ outside}$ (free-field)	55dB $L_{night,\ outside}$ (free-field)

Proposed Significance Criteria

Construction noise significance criteria

7.7.24 The magnitude of impact of construction noise shall be determined using the LOAEL and SOAEL values defined in paragraph 7.7.9 in accordance with the thresholds defined in Table 7.6.

Table 7.3 – Magnitude of impact and construction noise descriptions

Magnitude of impact	Construction noise level
Major	Above or equal to SOAEL +5dB
Moderate	Above or equal to SOAEL and below SOAEL +5dB
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

7.7.25 Construction noise may be considered a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; or
- a total number of days exceeding 40 in any 6 consecutive months.

7.7.26 The sensitivity of the receptor during the time period when the construction noise effect is expected to occur will also be a factor in determining if an effect is considered significant (for example, an effect at a school would only be considered significant during daytime hours).

Construction vibration significance criteria

7.7.27 The magnitude of impact of construction vibration shall be determined using the LOAEL and SOAEL values defined in paragraph 7.7.13 in accordance with the thresholds defined in Table 7-7.

Table 7.4 – Magnitude of impact and construction vibration descriptions

Magnitude of impact	**Construction vibration level (PPV)**
Major	Above or equal to 10 mm/s
Moderate	Above or equal to 1 mm/s and below 10 mm/s
Minor	Above or equal to 0.3 mm/s and below 1 mm/s
Negligible	Below 0.3 mm/s

7.7.28 Construction vibration may be considered a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; or
- a total number of days exceeding 40 in any 6 consecutive months.

7.7.29 The sensitivity of the receptor during the time period when the construction vibration effect is expected to occur will also be a factor in determining if an effect is considered significant.

Operational noise significance criteria

7.7.30 The initial and primary factor used to determine the significance of operational noise effects is the short-term change in noise level between the assessment scenarios described in paragraph7.7.18. The magnitude of change for the short- and long-term noise change are shown in Table 7.8.

Table 7.5 – Operation noise – magnitude of change

Magnitude of Change	Short-term Noise Change, dB $L_{A10,18h}$ or L_{night}	Long-Term Noise Change, dB $L_{A10,18h}$ or L_{night}
Major	5+	10+
Moderate	3 – 4.9	5 – 9.9
Minor	1 – 2.9	3 – 4.9
Negligible	0.1 – 0.9	0.1 – 2.9
No change	0	0

7.7.31 The initial assessment of likely significant effects will be based on the short-term magnitude of change as presented in Table 7-9.

Table 7.6 – Initial assessment of operational noise significance

Initial significance	Short term magnitude of change
Significant	Major
Significant	Moderate
Not Significant	Minor
Not Significant	Negligible
Not Significant	No change

7.7.32 For noise impacts with a short-term magnitude of change of minor, moderate or major, the final determination of significance will be based on a number of other contextual factors as follows, which are explained in more detail in Table 3.60 of LA 111:

- Noise level change (whether the magnitude of change is close to the minor/moderate boundary);
- Differing magnitude of impact in the long term to magnitude of impact in the short term;
- Absolute noise level with reference to LOAEL and SOAEL (by design this includes sensitivity of receptor);

- Location of noise sensitive parts of a receptor;
- Acoustic context; and
- Likely perception of change by residents.

7.7.33 As part of the determination of final significance, receptors may be grouped based upon factors such as location, setting or similarity of noise change to enable succinct presentation of the results.

7.8 Assessment assumptions and limitations

7.8.1 The inclusion of up to 4000 future dwellings proposed within the West Winch Growth Area, as specific sensitive receptors in the operational noise modelling is considered unfeasible given the outline nature of the development proposals, and therefore the absence of a fixed masterplan with building layouts. A commentary will be provided on the likely noise levels across the residential development parcels based on noise model contours and using parameter plans available in online planning documentation. It is not considered necessary to determine significance or explore mitigation measures for these new dwellings. This is because an assessment of the suitability of these sites for residential development with respect to noise should be considered as part of their respective planning applications. It is understood that the ongoing design of the West Winch Growth Area masterplan and subsequent planning applications are accounting for the WWHAR in their development proposals. If any specific mitigation for the West Winch Growth Area is confirmed at the time of this scheme's ES preparation, this will be incorporated as fully as possible into the noise assessment.

7.9 Factors and elements scoped in and out of further assessment

7.10 The elements to be scoped in for further assessment are summarised in Table 7.10

Table 7.7 – Noise and vibration elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Noise	Construction	Yes	No	There is the potential for temporary significant adverse effects from construction activities, and therefore this element has been scoped into the assessment.
Noise	Operation	Yes	No	There is the potential for significant adverse and beneficial noise effects during operation, and therefore this element has been scoped into the assessment.
Vibration	Construction	Yes	No	There is the potential for temporary significant adverse effects from construction activities, and therefore this element has been scoped into the assessment.

Element	Phase	Scoped In	Scoped Out	Justification
Vibration	Operation	No	Yes	Operational vibration is scoped out of the assessment methodology as a maintained road surface will be free of irregularities as part of project design and under general maintenance, so operational vibration will not have the potential to lead to significant adverse effects. This is the recommendation in DMRB LA 111.

8 Water environment

8.1 Study area

8.1.1 The study area has been defined as the physical area of the scheme under consideration and a buffer of 1km either side of the alignment for flood risk, water quality, hydrogeology and geomorphological assessments. The study area also includes any surface or groundwater bodies, or water dependent conservation sites located up to 5km downstream of the scheme. This is in accordance with DMRB LA 113 - Road drainage and the water environment (formerly HD 45/09) (LA 113 - Road drainage and the water environment).

8.1.2 These buffer distances are considered a conservative approach to address potential impacts upon the water environment receptors within and downstream of the study area.

8.2 Consultation

Consultation undertaken to date

8.2.1 There has been no consultation carried out to date with regards to the water environment.

Proposed consultation

8.2.2 Consultation with the Environment Agency (EA) will include data requests for licensed abstractions and discharges data in the surrounding area.

8.2.3 Consultation with the EA to confirm the scope to assess the risks of activities in relation to the Water Framework Directive (WFD).

8.2.4 Consultation with NCC to identify private water supplies in the surrounding area.

8.2.5 Consultation with the NCC as Lead Local Flood Authority will include the review of planning applications in respect of surface water drainage.

8.3 Baseline conditions

Baseline data collected to date

8.3.1 The following information has been gathered through desk studies to establish the existing conditions of the surface and groundwater environment.

8.3.2 The data has been provided with reference to the following key sources of information, where necessary:

- EA Catchment Data Explorer (England | Catchment Data Explorer);
- EA Statutory Main River Map (Statutory Main River Map (arcgis.com));
- EA Flood Map for Planning (EA (2020) Flood Map for Planning);
- EA Long Term Flood Risk Map for England (EA (2019) Long Term Flood Risk Map for England);
- EA Drinking Water Safeguard Zones and Nitrate Vulnerable Zones Mapper (EA (2021). Check for Drinking Water Safeguard Zones and NVZs.) ;
- Ordnance Survey Opendata (Ordnance Survey (2021) Open Data);
- Aerial Imagery via Bing Aerial (Bing (2018) Aerial Imagery);
- Defra Magic Map online GIS portal (Defra (2021) Magic Map);

- British Geological Survey (BGS) Onshore GeoIndex Online Mapper (BGS (2020) Onshore GeoIndex Online Mapper);
- BGS Map Portal online database. Kings Lynn and The Wash Map Sheet 145, 1:50,000 Series (BGS (1978) Map Portal online database. Kings Lynn and The Wash Map Sheet 145, 1:50,000 Series.);
- BGS Map Portal online database. Hydrogeological map of Northern East Anglia Sheet 2 (BGS (1976) Map Portal online database. Hydrogeological map of Northern East Anglia Sheet 2);
- Cranfield Soil and Agrifood Institute Soilscapes Online Map (Cranfield Soil and Agrifood Institute (2017) Soilscapes Online Map); and
- Norfolk Partnership Laboratory (NPL) Factual Report West Winch Relief Road Norfolk (February 2021) (NPL (2021) West Winch Relief Road Norfolk Factual Report (Report Number 100746).).

Designated sites

8.3.3 Defra Magic Map indicates that there are two designated sites within 5km of the Site.

8.3.4 River Nar Site of Special Scientific Interest (SSSI) (ID: 1001656) is located approximately 200m west of the northern extent of the scheme and is designated for its progression from chalk river to fen river. The scheme is drained by a number of tributaries of the River Nar, therefore is hydrologically connected to the SSSI.

8.3.5 Setchey SSSI (ID: 1001984) is located approximately 1.1km south of the southern extent of the scheme and is designated for its flandrian deposits. The SSSI is located within the River Nar catchment but it is not hydrologically connected to the scheme.

8.3.6 There are no other nationally or internationally designated sites within 1km, or hydrologically linked to the scheme.

Surface water

8.3.7 The scheme falls in the North West Norfolk management catchment, within the Anglian River Basin District, and features two watercourses classified under the WFD (2019).

8.3.8 The Country Drain (ID: GB105033047770) (also known as Puny Drain) flows from east to west on the south side of the scheme, crossed by the existing A10 at NGR 563625, 313567. From here, it flows north-west and then north to the west of West Winch, draining numerous field drains along its course, before flowing via culvert, crossed by the River Nar at NGR 562117, 318299, north-west until its confluence with the River Great Ouse at NGR 561488, 318790. This watercourse has an overall status of 'Poor', an ecological status of 'Poor', and a chemical status of 'Fail'. The watercourse has a 'Poor' ecological status due to Macrophytes and Phytobenthos classification elements related to sewage discharge activity. The hydromorphological designation for the watercourse is 'not designated artificial or heavily modified'.

8.3.9 The Middleton Stop Drain (ID: GB105033047670) (also known as Pierpoint Drain) flows from east to west on the northern extent of the scheme, draining numerous field drains. It is crossed by the existing A149 at NGR 563715, 318567, then flows west, crossed again by the A149 at NGR 562606, 318718, then continuing to its confluence with the River Nar at NGR 562202, 318774, immediately after being crossed by the existing A148. This watercourse has an overall status of 'Moderate', an ecological status of 'Moderate', and a chemical status of 'Fail'. The watercourse has a 'Moderate' ecological status as a result of physical modifications, including urbanisation and land drainage. The failure in chemical status is due to the presence of nickel and its compounds. The hydromorphological designation for the watercourse is 'heavily modified'.

8.3.10 The scheme is located within the Country Drain Surface Water Nitrate Vulnerable Zone (ID: 388).

8.3.11 There are a number of ponds in the vicinity of the scheme, which have been identified using OS mapping and aerial imagery, with three ponds located within 250m and a total of five ponds located within 500m of the scheme.

8.3.12 There are no Statutory Main Rivers within the scheme boundary; however, there are two Main Rivers, River Nar and River Great Ouse, hydrologically connected to the scheme via the drains noted above. It should be noted that there are a number of field drains that contribute to local surface water resources, including agricultural, commercial and recreational uses, in the catchments around the scheme.

Groundwater

8.3.13 The scheme falls within the WFD groundwater body North West Norfolk Sandringham Sands (ID: GB40501G400400) classified as holding a 'Good' status for both quantitative and chemical classifications (Cycle 2 for 2019 monitoring results). The water body is protected under the Nitrates Directive and Drinking Water Protected Area. The scheme is located within the Sandringham Sands South Groundwater Nitrate Vulnerable Zone (ID: 150).

8.3.14 Superficial deposits comprising Head Deposits, Lowestoft Formation and Tottenhill Gravel Member are low productivity aquifers of limited or local potential. The EA classifies these units as Secondary A (Tottenhill Gravel Member) and Secondary (undifferentiated) aquifers (Head Deposits and Lowestoft Formation). Secondary A aquifers are described as permeable layers capable of supporting water supplies on a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. Secondary Undifferentiated are assigned in cases where it has not been possible to attribute either a Secondary A or Secondary B aquifer to a rock type. The Ground Investigation (GI) completed in 2020 has confirmed that these deposits directly underlie, or are present at shallow depths, within the Study Area.

8.3.15 The bedrock geology comprises from north (A47) to south (A10 at Setch Road) the Kimmeridge Clay Formation (predominantly mudstone) and

Sandringham Sand Formation (comprising silty and clayey sands). The Sandringham Sand Formation is subdivided into the following; Members; Roxham Member and Runcton Member, Mintlyn Member and Leziate Member. The 2020 GI has confirmed that these deposits underlie the Study Area at shallow depth.

8.3.16 The Sandringham Sand Formation is designated a Principal aquifer that are deemed capable of supporting water supplies at a regional scale, meaning they usually provide a high level of water storage that may also support water supply and/or river base flow on a strategic scale.

8.3.17 The Kimmeridge Clay Formation is designated Unproductive Strata with low permeability and negligible significance for water supply or river baseflow. The Kimmeridge Clay underlies the Sandringham Sand Formation within the Study Area.

8.3.18 Locally, groundwater flow direction, while generally westerly towards the River Nar (approximate elevation of 4.0mOD), will be variable and influenced by local changes in topography, as well as the aquifer geometry e.g. the presence of clay layers, tidal fluctuations and rainfall.

8.3.19 In general, groundwater levels relating to the 2020 GI were shallow relative to the ground surface along the scheme for bedrock deposits. Discontinuous groundwater level monitoring data are available for six window sample locations (WS101 – WS103 and WS105 – WS107, inclusive) between August 2020 and February 2021. Manual dips are available only and a summary of the data collected are provided in Table 8-1 below.

Table 8.1 – Groundwater level monitoring data between august 2020 – February 2021

ID	Elevation	Formation	Groundwater Elevation (mOD) Min	Groundwater Elevation (mOD) Max	Groundwater Elevation (mOD) Average
WS101	19.92	Sandringham Sands Formation	17.13	18.72	17.70
WS102	18.18	Lowestoft Till Formation	17.28	18.08	17.51
WS103	19.18	Tottenhill Gravels Member & Sandringham Sands Formation	17.36	18.56	17.91
WS105	16.54	Tottenhill Gravels Member & Sandringham Sands Formation	13.13	15.44	13.86
WS106	11.70	Tottenhill Gravels Member & Sandringham Sands Formation	10.15	11.09	10.58
WS107	10.71	Tottenhill Gravels Member & Sandringham Sands Formation	8.91	10.00	9.42

8.3.20 Shallow groundwater levels were recorded at 0.10m BGL (18.08mOD) in WS102 in December 2020 and the deepest at 3.41m BGL (13.13mOD) in WS105 in August 2020. Based on the information provided in Table 8-1, the superficial and bedrock aquifers are considered potentially susceptible to possible factors which may potentially affect their quantity regimes from near surface influences.

8.3.21 Infiltration testing was completed for four window sample locations (WS102, WS103, WS105 and WS107). On average, three tests were completed at each location and a summary of results provided in Table 8-2 below. Note that only one test was undertaken for WS102 where infiltration was not possible due to lithology encountered.

Table 8.2 – Infiltration test summary

ID	Formation	Test Depth (m BGL)	Infiltration Rate (m/sec) Min	Infiltration Rate (m/sec) Max	Infiltration Rate (m/sec) Average
WS102	Lowestoft Till Formation	4.90	4.4E-09		
WS103	Tottenhill Gravels Member & Sandringham Sands Formation	1.50	1.50E-05	2.0E-05	1.73E-05
WS105	Tottenhill Gravels Member & Sandringham Sands Formation	3.25	3.50E-06	9.20E-06	5.57E-06
WS107	Tottenhill Gravels Member & Sandringham Sands Formation	1.70	7.20E-05	7.70E-05	7.43E-05

8.3.22 No groundwater water quality data are available from the GI (2020). Consultation with the EA and NCC is currently underway for additional groundwater quality data that will feed into the ES.

8.3.23 The Groundwater Vulnerability Map**Error! Bookmark not defined.** shows the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological and hydrogeological properties within a single square kilometre. The Sandringham Sand Formation (north of the Study Area) is classified as High and Medium risk which means that these units can transmit pollution to groundwater easily. The Tottenhill Gravel Member and Lowestoft Formation is classified as Medium – Low risk which indicates that if there is a pollution event on the surface the area will offer some groundwater protection.

8.3.24 The scheme is not located within a Source Protection Zone (SPZ). The nearest SPZ, Inner Protection Zone (Zone 1) is approximately 9.4km to the south-east and 12.0km to the north-east of the Proposed Scheme, relating to abstractions at Narborough and Grimston respectively.

8.3.25 No Groundwater Dependent Terrestrial Ecosystems (GWDTE) have been identified at this stage and will be considered at ES stage.

Flood risk

8.3.26 The majority of the scheme falls within Flood Zone 1, with a small proportion of the northern extent within Flood Zone 2, according to the EA Flood Map for Planning.

8.3.27 The EA Long-Term Flood Risk map does not identify any river flood risk areas within the scheme footprint. However, the mapping suggests that there is a high localised risk of surface water flooding, limited to areas immediately adjacent to field drains.

8.3.28 The Kings Lynn and West Norfolk Level 1 Strategic Flood Risk Assessment (JBA Consulting (2018) King's Lynn and West Norfolk Strategic Flood Risk Assessment. Final Report Level 1) groundwater flood mapping shows that the

scheme is susceptible to groundwater flooding. The southern extent (Setch Road at A10) is susceptible to >25%<50% groundwater flood risk. The northern extent (from North Runcton to A47) is susceptible to <25% groundwater flood risk.

Abstractions

8.3.29 No information was available at this stage on licensed abstractions, public and/or private water supplies.

8.3.30 A request for licensed abstraction data and private water supplies will be made to the EA, NCC and the relevant water company to inform the ES.

Proposed baseline data collection

8.3.31 A hydrological walkover survey will be undertaken to capture baseline conditions of any relevant hydrological features and proposed watercourse crossings.

8.3.32 GI works began May 2020 to identify ground condition and collect monitoring data (including groundwater level). Groundwater level monitoring is ongoing and the data collected will be considered and assessed in the ES.

8.3.33 If deemed necessary, further investigation will be undertaken prior to construction in order to verify indicative locations of water supply sources provided by NCC, and to confirm the supply type, properties supplied and their uses. As noted above, information on licensed abstractions will be obtained from the EA.

8.4 Mitigation measures

8.4.1 Good practice construction environmental management principles will reduce the likelihood and magnitude of pollution incidents occurring. The production of a CEMP will detail key mitigation measures to be adopted and specific roles and responsibilities for ensuring compliance, including monitoring activities.

8.4.2 Engineering interactions with the water environment include watercourse crossing structures, watercourse realignments and outfalls. Each of these development features will be designed taking into account good practice guidance and the characteristics and sensitivities of local water receptors.

8.4.3 The increase in surface water runoff created by the increase in impermeable area should be mitigated through the use of Sustainable Drainage Systems (SuDS) and the design is likely to feature attenuation ponds and soakaway drainage where practicable. SuDS systems also provide water quality treatment, mitigating potential adverse effects from highway drainage by treating sediment, sediment-bound contaminants and soluble contaminants prior to discharge.

8.5 Description of likely significant effects

8.5.1 It would be anticipated that good construction practice, application of appropriate watercourse crossing structures, watercourse realignments and discharge locations within a sustainable drainage design would avoid significant water quality and hydromorphological effects during both construction and operation.

8.5.2 It is currently envisaged that the increase in surface water runoff can be attenuated on-site with discharge limited to greenfield rate or the current discharge rate. This has yet to be fully assessed and the potential for significant effects in terms of flood risk and hydromorphological impacts will be further assessed and detailed within the ES.

8.5.3 Potential significant effects on surface water, groundwater and flood risk are outlined below:

Potential effects on surface water

- Pollution during construction due to increased generation and release of sediments and suspended solids, and increased risk of accidental spillage of pollutants such as oil, fuel and concrete associated with construction activities and site storage requirements;

- Pollution during operation due to contaminants within routine road runoff. A broad range of potential pollutants, such as hydrocarbons i.e. fuel and lubricants, fuel additives, metal from corrosion of vehicles, de-icer and gritting material, may accumulate on road surfaces. These can subsequently be washed off the road surface during rainfall events, polluting the receiving surface water bodies;
- Pollution during operation due to spillage. On all roads there is a risk that accidents or vehicle fires may lead to an acute pollution incident. Where commercial vehicles are involved, potential pollutants that may be spilled could range from hazardous chemicals to milk, alcoholic beverages, organic sludges and detergents. Spilled materials may drain from the road surface, polluting the receiving surface water bodies;
- Alterations to the hydromorphology (fluvial geomorphological) regime, such as increased erosion, deposition and channel migration processes. These changes can occur as a result of channel modification associated with increased road surface drainage, new crossing structures, culverting, watercourse diversions and outfalls. A reduction in hydromorphological diversity can subsequently impact on water quality and biodiversity;
- Loss of standing waters where the scheme would be constructed through or close to existing ponds; and
- Loss or change to water supplies due to degradation of water quality, changes in drainage patterns or disruption to supply infrastructure.

Potential effects on groundwater

- Pollution of groundwater and aquifers as a result of construction activities such as excavation of cuttings and seepage of spillages through ground profiles;

- Groundwater pollution during operation due to contaminants within routine road runoff, where discharge to ground is proposed as part of the drainage strategy for the scheme;
- Groundwater pollution during operation due to spillage;
- Direct loss or changes to groundwater aquifers and groundwater supported public and private water supplies, either below the footprint of the scheme, or as a result of changes to groundwater flows and levels associated with the dewatering of cuttings and below ground structures (creating groundwater flow barriers);
- Indirect loss or change to surface water receptors, as a result of dewatering of groundwater aquifers or change of groundwater flow direction; and
- Loss or changes to Groundwater Dependent Terrestrial Ecosystems (GWDTEs), either below the footprint of the scheme, as a result of severance of habitat or as a result of changes to groundwater flows and levels associated with dewatering activities.

Potential effects on flood risk

- Increase in flood risk caused by the scheme, both within the vicinity of the scheme and also elsewhere in the catchment. This can involve a number of inter-related factors including:
    - Increases in upstream water level caused by any restriction in flow (afflux) and conversely increases in downstream water levels where existing restrictions are removed;
    - Loss of floodplain storage due to road infrastructure occupying areas which were previously available for flood storage or flows;
    - Increase of groundwater levels due to barrier effects of below ground structures; and

- Impediment of water flow caused by road infrastructure crossing existing drainage channels, causing potential blockage and altering local catchment area boundaries.

8.6 Enhancement measures

8.6.1 No enhancement measures have been identified at this stage.

8.7 Proposed assessment methodology

8.7.1 The assessment will focus upon defining the characteristics and subsequent potential scheme impacts upon the surface water and groundwater receptors, including the wider hydrological catchments as categorised by the EA under the WFD. This hydrological catchment-based approach enables due consideration to be given to both individual locations where interactions occur and any cumulative impacts within larger water body areas.

Construction pollution

8.7.2 Evaluation of the potential for pollution of surface waters as a result of spillage and of the release of sediments into watercourses or water bodies will involve a review of areas where construction would be required within or in close proximity (within 50m) to surface watercourses and water bodies. The potential for pollution of groundwaters/aquifers is greatest where cuttings are proposed.

8.7.3 Potential impacts during construction will be assessed qualitatively.

Pollution from routine runoff

8.7.4 DMRB LA 113 specifies procedures for the assessment of pollution impacts from routine runoff on surface waters. This assessment comprises two separate elements:

- Highways England Water Risk Assessment Tool (HEWRAT) Assessment: the HEWRAT is a Microsoft Excel application designed to assess the short-term risks related to the intermittent nature of road runoff. It assesses the acute and chronic pollution impacts on aquatic

ecology associated with soluble and sediment bound pollutants, respectively; and,

- Environmental Quality Standards (EQS) Assessment, which is embedded within the HEWRAT application: EQS are the maximum permissible annual average concentrations of potentially hazardous chemicals, as defined under the WFD. The long-term risks over the period of one year are assessed through comparison of the annual average concentration of pollutants discharged with the published EQS for those pollutants.

Pollution from spillage

8.7.5 DMRB LA 113 specifies procedures for the assessment of pollution impacts from spillage.

8.7.6 The assessment takes the form of a risk assessment, where the risk is expressed as the annual probability of a serious pollution incident occurring. This risk is the product of two probabilities:

- The probability that an accident will occur, resulting in a serious spillage of a polluting substance on the carriageway; and
- The probability that, if such a spillage did occur, the polluting substance would reach the receiving water body and cause a serious pollution incident.

Loss or change to groundwater aquifers and supported water supplies

8.7.7 Groundwater aquifers shall be identified, and their sensitivity evaluated through review of BGS aquifer productivity, groundwater vulnerability mapping and WFD status. GI data, commissioned for the design process, will be assessed to develop a Conceptual Site Model, with focus on groundwater levels and groundwater flow direction/flow characteristics, which will be used to qualitatively or quantitatively, assess the impacts of proposed earthworks, below ground structures and drainage strategy.

8.7.8 Groundwater abstraction data will be identified, and receptors noted, with public water supplies of particular concern.

Indirect loss or change to surface water receptors

8.7.9 Surface water bodies such as streams, lakes and wetlands can receive or recharge groundwater, with movement likely between the two receptors. Any changes to groundwater as a result of dewatering may indirectly impact surface water bodies and result in changes to surface water flow.

8.7.10 The impact on surface water receptors shall be assessed qualitatively.

Increased flood risk

8.7.11 A Flood Risk Assessment (FRA) has been carried out in accordance with the National Planning Policy Framework, and the supporting document Technical Guidance to the National Planning Policy Framework.

8.7.12 The objectives of the FRA are to:

- Assess the risk to the scheme from all potential sources of flooding (including groundwater, river (fluvial), surface water (pluvial), estuary/coastal (tidal), or from sewer sources);
- Assess the risk of increasing flooding elsewhere as a consequence of the scheme; and
- Determine appropriate mitigation measures to limit the impact of flooding on the scheme and offsite flooding due to increased runoff.

8.7.13 The flood risk baseline has been established through desk study, field survey and the assessment outcome are being consulted on with the Lead Local Flood Authority (LLFA). A drainage assessment will be carried out for the scheme. The need for hydraulic modelling of local watercourses will be determined through consultation with the EA and LLFA.

Proposed significance criteria

8.7.14 The predicted significance of impacts on surface water and groundwater receptors will be based on the importance or sensitivity of the relevant water

body and the magnitude of the impact from the scheme, as recommended in DMRB LA 113.

8.7.15 The importance or sensitivity of the water bodies will be evaluated taking into account their quality, rarity, scale and substitutability. The criteria used will be based on the guidance and examples given in DMRB LA 113.

8.7.16 The magnitude of impacts will be evaluated taking into account the extent of loss and effects on integrity of the relevant water body attributes. The criteria used will be based on the guidance and examples given in DMRB LA 113.

8.7.17 The estimation of the significance of effects will be derived by combining the estimated importance of the affected water bodies and the magnitude of the impacts, taking into account mitigation and the guidance provided in DMRB LA 104 (DMRB (2020). LA 104 – Environmental assessment and monitoring). Effects can be beneficial or adverse, and their significance very large, large or very large, moderate or large, moderate, slight or moderate, slight, neutral or slight, or neutral, as set out in DMRB LA 104.

8.8 Assessment assumptions and limitations

8.8.1 This EIA Scoping Report is based on currently available information and can be subject to change as the design progresses. This is of particular importance when considering potential impacts associated with the quality of surface water runoff, hydromorphology and channel hydraulics and flood risk.

8.8.2 This assessment has relied upon the accuracy and level of detail of the documented data sources reviewed as part of the desktop assessment where no site visits are anticipated to be conducted. For instance, the identification of water bodies and their characteristics has involved reference to EA data and the associated WFD water body information. The datasets are updated annually and the latest available information (2019) has been included. It is possible that during the intervening period conditions within the water bodies may have changed.

8.8.3 EA Flood Maps are indicative and provide a strategic national overview of areas estimated to be at risk of flooding from reservoirs, surface water, river and/or sea. It is noted that these maps have limitations, as these are based on broad scale hydrological and hydraulic modelling techniques along with digital terrain models. They also do not take account of hydraulic structures or flood prevention schemes. However, the flood maps are a valuable tool when screening and identifying flood sources and potential flood extents for initial consideration, to enable determination of additional data or modelling requirements in due course.

8.8.4 Data from the FRA and from the EA has been used to determine the local flood risk. The FRA and Drainage Strategy (once available) will be reviewed as part of the scheme assessment and reported in the ES.

8.8.5 Outline and detailed design of drainage features, watercourse diversions and compensatory storage were not available at the time of preparing this EIA Scoping Report.

8.8.6 Discharge consents, certificates and environmental permits were not available at the time of preparing this EIA Scoping Report.

8.8.7 A response from NCC following a data request has not been received in time to support this EIA Scoping Report and therefore the ES may scope in or out additional features identified through the data request response.

8.8.8 Any gaps in information identified at this scoping stage will be considered and addressed along with specific mitigation measures as part of the assessments to produce the ES.

8.8.9 A GI has been undertaken but baseline data collection is still ongoing. Additional data will be considered and assessed at ES stage.

8.9 Factors and elements scoped in and out of further assessment

8.9.1 The factors to be scoped in for further assessment are summarised in Table 8.3

Table 8.3 – Water environment elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Pollution to surface water and groundwater	Construction and Operation	Yes	No	Potential for effects on surface and groundwater from construction activities. Potential for impacts to be considered in the operation of the road due to routine runoff and/or operational spillage.
Loss or change to water supplies	Construction and Operation	Yes	No	Potential for effects on water supplies due to degradation of water quality, changes in drainage patterns, disruption to supply infrastructure, or as a result of changes to groundwater flows and levels, associated with the dewatering of cuttings and below ground structures.
Direct loss or changes to groundwater aquifers	Construction and Operation	Yes	No	Potential for effects on groundwater aquifers due to proposed earthworks, below ground structures and drainage strategy.
Indirect loss/change to surface water receptors	Construction and Operation	Yes	No	Potential impacts as a result of dewatering of groundwater aquifers.

Element	Phase	Scoped In	Scoped Out	Justification
Flood Risk	Construction and Operation	Yes	No	Further assessment is required to determine potential Flood Risk effects of the works, including fluvial and pluvial flood risk, reservoir flood risk, ponds, ordinary watercourses, groundwater and existing flood defence assets.
Loss of standing water	Operation	Yes	No	Potential for reduction in standing water due to impacts of the road on surface water and groundwater movements.
Loss or change to Groundwater Dependent Terrestrial Ecosystems	Operation	Yes	No	Potential effects on ecosystems supporting species within the footprint of the scheme to be further explored to determine if impacts will be experienced.
Groundwater levels	Operation	Yes	No	Impacts on groundwater levels or flows to be assessed as a result of cuttings and related dewatering as a result of the scheme.
Alteration to hydromorphological regime	Operation	No	Yes	Lack of main watercourses within close proximity to the scheme with only field drains identified within this report.

Element	Phase	Scoped In	Scoped Out	Justification
Detailed WFD assessment	Construction and Operation	No	Yes	Lack of main watercourses within close proximity to the scheme with only field drains identified within this report.

9 Geology and soils

9.1 Study area

9.1.1 The assessment of geology and soils considers a study area that includes the scheme and a radial study area (500m based on professional judgement) around the scheme.

9.1.2 The extent of this zone has been developed using professional judgement on the basis that contamination migration beyond this distance is likely to be negligible.

9.2 Consultation

Consultation undertaken to date

9.2.1 No consultation specific to geology and soils has been undertaken to date.

Proposed consultation

9.2.2 Consultation will be undertaken with NCC regarding the safeguarded mineral resources which are indicated in the scheme area to assess the importance of these resources and understand any proposed mineral extraction, planning or development restrictions.

9.3 Baseline conditions

Baseline data collected to date

9.3.1 This assessment has been prepared utilising existing sources of information. To inform the assessment, exiting uses, soil, geological, hydrogeological, and

hydrological conditions have been reviewed to establish the baseline conditions of the study area. The baseline conditions also assess the potential receptors of contamination.

9.3.2 An understanding of the likely existing baseline environmental settings in terms of geology, mineral resources, geological features and contamination has been established with references to the key information sources provided in Table 9.1.

Table 9.1 – Key information sources

Source	Data	Comment
British Geological Survey (BGS)	Solid and Drift BGS Map Sheet 145 and 129 – Kings Lynn and the Wash (1:50,000, 1978) BGS Geological of Britain Viewer (accessed January 2021)	Provides information on both the Superficial and Bedrock geology underlying the proposed cable route. Helps determine the likely ground conditions and contaminant pathways.
Magic Map Website	Natural England Multi-Agency Geographic Information for the Countryside (MAGIC) website (accessed January 2021);	Provides information on EA Aquifer Designations, Statutory and Non-statutory sites, and EA Source Protection Zones (SPZ). Helps to determine likely receptors.
Landmark Information Group	Landmark Envirocheck Report (Ref:201802532_1_1)	Primary repository of information relating to historical land uses, pollution incidents to controlled waters, landfills, ecology, mineral extraction sites, waste management facilities, discharge consents, geology, water abstractions, and local authority pollution prevention and controls etc. Information helps to identify potential sources of contamination, receptors and also pathways.

Source	Data	Comment
WSP Preliminary Risk Assessment	WWHAR Preliminary Risk Assessment (Ref:70039893-PRA) dated June 2019.	PRA prepared by WSP provides information needed for the baseline of the assessment, including, geology, hydrogeology, hydrology, mineral extraction, landfills, previous land uses, contamination and a conceptual site model.
WSP Ground Conditions Appraisal	West Winch Relief Road Ground Conditions Appraisal (Ref:70039893) dated January 2021	A ground conditions appraisal prepared by WSP, using information from a Ground Investigation carried out by Norse Group in 2020. Useful in determining the ground conditions along the route and information on groundwater levels. Helps determine potential sources of contamination, pathways and receptors. Report includes a geotechnical assessment and a Generic Quantitative Risk assessment including a updated Conceptual Site Model.

9.3.3 The overview indicated that the topography of the area is generally flat and level. It is understood that there are a number of surface water features in the general area, many of which are agriculture drainage ditches 1-2m wide. During a site survey carried out in November 2018, the drainage ditches supported little water.

Geology

9.3.4 The geology along the length of the scheme is variable; this variability is likely to have an impact on design of the scheme. Information obtained from British Geological Survey Maps, WSP Preliminary Risk Assessment and WSP Ground Conditions Appraisal have been used to determine the geology beneath topsoil along the proposed route.

Superficial deposits

- Alluvium: (located in the northern portion of the scheme). During the ground investigation in 2020 only one location encountered this deposit and comprised dark grey, sandy silty clay with occasional roots and a slight organic odour. This deposit measured 1m thick.
- Head: (located in the southern portion of the scheme). During the ground investigation in 2020 the head deposit encountered comprised mottled orange brown and grey silty, gravelly fine to medium sand with sub-angular to subrounded flint gravels. These deposits measured 1.50m thick.
- Raised Beach Deposits (located in a relatively limited area). This material typically comprises shingle, sand, silt and clay. This was not encountered during the ground investigation in 2020.
- Lowestoft Formation (located within the central and southern portion of the scheme): During the ground investigation in 2020 the deposit comprised firm to very stiff orange brown to dark grey, sandy, silty gravelly clay, with fine to coarse angular to sub-rounded flint, chalk and mudstone gravels. The deposit ranged in thickness between 0.40m to 4.80m.
- Tottenhill Gravel Member: (located within the central and southern portion of the scheme). During the ground investigation in 2020 the deposit comprised dark brown to brownish grey, clayey, silty gravelly fine to medium sand with fine to coarse angular to sub-rounded flint, quart, ironstone and carstone gravels. The deposit ranged in thickness between 0.40m and 1.85m.

Bedrock geology

- Leziate Member – Sand: (located in a relatively limited area). Typically, comprises grey and white fine-grained quartz sands. This was not encountered during the ground investigation in 2020.

- Mintlyn Member – Sand: (located throughout the scheme). During the ground investigation in 2020 the deposit comprised light brown to dark grey silty, gravelly fine to medium sand with laminations and thin beds of weak to moderately weak sandstone, ironstone and siltstone. Cohesive deposits were encountered and comprised stiff mottled reddish-brown sandy gravel clay with fine to coarse angular to sub-rounded flint, ironstone, chert and phosphatic nodules gravels. The deposit ranged in thickness between 0.50 to 4.60m.

- Roxham and Runcton Members – Sand: (located throughout the scheme). During the ground investigation in 2020 the deposit comprised firm to stiff silty sandy clay and dark grey to brown silty, gravelly fine to medium sand, with fine to medium subrounded flint, sandstone, pyrite nodules and phosphate nodules gravels. The deposit ranged in thickness between 0.20 to 2.60m.

- Kimmeridge Clay: (located in the northern and southern portion of the scheme). During the ground investigation in 2020 the deposit comprised firm to stiff dark grey to bluish grey laminated clay with lenses of light grey silty fine sand and occasional shell fragments. The maximum depth encountered was 5.45m bgl due to exploratory holes terminating within this stratum.

Hydrogeology

9.3.5 The Head and Lowestoft Formation of the superficial drift are designated as a Secondary Undifferentiated Aquifer and the Tottenhill Gravel Member, Raised Beach Deposits and Alluvium are designated as a Secondary A Aquifer.

9.3.6 The bedrock geology's of Mintlyn Member, Leziate Member and Roxham and Runcton Members are designated as a Principal Aquifer. The Kimmeridge Clay is designated as an Unproductive Stratum.

9.3.7 In addition, the bedrock is further designated as a Major Aquifer (Intermediate to High) in terms of groundwater vulnerability.

9.3.8 The scheme is not within a Source Protection Zone (SPZ).

9.3.9 During the ground investigation in 2020 groundwater was encountered within the predominantly granular strata, such as the Tottenhill Sands and Gravels. Mintyln Member and Roxham and Runcton Beds as well as within the Lowestoft Formation and ranged from 0.10m bgl to 3.41m bgl.

Hydrology

9.3.10 The River Nar is the nearest named river that is classified as a Main River and lies approximately 2.2km to the west of the scheme. The River Great Ouse lies beyond, approximately 3km to the west of the scheme. The Puny Drain is located approximately 1.3km west of the scheme. This drain receives discharges from numerous field drains along its course.

9.3.11 The Pierpoint Drain (Middleton Stop Drain) is located approximately 300m north-east of the northernmost point of the scheme (Hardwick Interchange) at its closest point. It flows from east to west on the north of the scheme towards the River Nar.

9.3.12 There are also several unnamed ditches and bodies of water (ponds or pooling of surface water) observed on OS mapping including a reservoir located approximately 600m to the east of the southern extent of the scheme.

9.3.13 For further details on water quality and status in the vicinity of the scheme, refer to Chapter 8, Water Environment.

Land affected by contamination

9.3.14 From the WSP PRA and Ground Conditions Appraisal, the following information on areas of potential concern with respect to contaminated land, have been identified to date:

- Agricultural land use with a potential of use of herbicides and pesticides;
- Current and historical roads due to possibility of migration of contamination via fugitive dust or surface flow from any road spills;

- Historical railway located towards the north of the scheme;
- Inactive clay pit located towards the north of the scheme;
- Current and historical landfills located within 500m of the southern extent of the scheme; and
- Petrol filling station located 500m to the west of the scheme at the northern extent.

9.3.15 A Generic Risk Assessment was undertaken on the soil samples and groundwater samples taken during the ground investigation in 2020. A direct comparison of Generic Assessment Criteria (GAC) and Category Four Screening Levels (C4SLs) for public open space was undertaken for the analytical results of the soil samples.

9.3.16 No exceedances were noted within the soil samples taken across the scheme route. It should also be noted that the results were below the threshold for the most conservative end use (residential with plant uptake). No asbestos was detected within the soil samples taken across the scheme route.

9.3.17 Groundwater samples were screened against the Water Quality Standards for groundwater and surface water. There were a number of exceedances above the Water Quality Standards for surface water across the route scheme, these exceedances include copper, nickel, zinc, fluoranthene, benzo(a)pyrene and total polyaromatic hydrocarbons (PAH). There was one exceedance above the water quality standards for groundwater for benzo(a)pyrene. As no exceedances were noted to the samples soils and there is limited on-route sources the GQRA concluded that the elevated concentrations above the Water Quality Standards were likely representative of regional background conditions.

Designated sites

9.3.18 There are no Regionally Important Geological Sites (RIGS) within 500m of the scheme.

Biodiversity

9.3.19 There are several sites designated for nature conservation within 500m of the scheme. Further information regarding these sites can be found within Chapter 5: Biodiversity.

Agricultural land

9.3.20 The scheme is located within agricultural land, classified as Grades 2 and 3, as highlighted within the Environmental Constraints Plan (Appendix B). Government guidance (UK Government Guidance: Guide to assessing development proposals on agricultural land) limits development on Grades 1, 2 and 3a farmland, known as 'Best and Most Versatile' (BMV) land. The majority of the land to be affected by the scheme is located within Grade 2 land.

Safeguarded mineral resources

9.3.21 An initial desktop review of the Norfolk Minerals and Waste Core Strategy indicates that the sand geology beneath the scheme is a safeguarded mineral resource. Policies are in place to ensure that mineral resources (silica sand beneath the scheme are safeguarded to ensure future resources are not built upon and to avoid detrimental impact of the mineral resource through development. Silica sand resources in Norfolk are considered to be of national strategic importance.

Sensitive receptors

9.3.22 The following receptors may be impacted by potential sources of contamination within the study area:

- Construction workers;
- Controlled Waters (Secondary A and Undifferentiated superficial aquifers, Principal bedrock aquifer, River Nar, Puny Drain and various minor watercourses, ponds reservoirs and drainage ditches);
- Future site users (including road and pavement users and maintenance workers);

- Off-site users in the immediate vicinity of the scheme (including nearby residents);
- Off-site properties and foundations; and
- Underground services and concrete.

Proposed baseline data collection

9.3.23 The PRA and ground investigation in 2020 will be used to inform what targeted ground investigation are to be carried out throughout the design stages for environmental, engineering and construction purposes. The purpose of any additional investigation will be to confirm the mineral resource, the presence or absence of contamination, determine the classification of material for future re-use or off-site disposal, and to derive engineering parameters for use in design of the scheme structures. The information recorded from the ground investigation will be reported in a Ground Investigation Report (GIR), and subsequently used in design and reported by a way of a Generic Quantitative Risk Assessment.

9.4 Mitigation measures

9.4.1 There are a broad range of potential mitigation measures that could be implemented to mitigate potentially significant effects of the scheme on ground conditions both for construction and operational phases of the scheme. These could include, but are not limited to:

- Requirement for further targeted ground investigation; this will be undertaken to inform on the design of the scheme as well as to allow characterisation and quantification of the contamination risks;
- Ground and/or groundwater remediation (if required);
- A Verification report will be required to confirm the successes of the remediation (if required);

- Implementation of best practice environmental management techniques during construction such as the development and implementation of a CEMP and a Site Waste Management Plan; and
- Development-led construction design elements to reduce exposure to receptors.

9.5 Description of likely significant effects

9.5.1 Following mitigation, it is considered there would be no significant effects on construction workers and future maintenance workers and site users, controlled waters, structures and services, agricultural land or mineral resources. However, a targeted ground investigation is needed to confirm the ground and groundwater conditions present, the level of contamination (if any) and inform the mitigation measures that may be required.

9.6 Enhancement measures

9.6.1 No enhancement measures have been identified at this stage for the construction or operational phases of the scheme, these may be identified as the design progresses.

9.7 Proposed assessment methodology

9.7.1 The applicable legislative framework and guidance is summarised as follows:

- Environmental Protection Act 1990;
- Contaminated Land (England) (Amendment) Regulations 2012;
- Water Framework Directive (WFD) 2000/60/EC;
- Construction (Design and Management) Regulations 2015;
- Land Contamination: Risk Management (LCRM) (Environment Agency. (2020). Land Contamination: Risk Management (LCRM));
- Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance 2012; and

- Design Manual Roads and Bridges (DMRB) LA 109, Geology and Soils.

9.7.2 A phased approach will be undertaken to assess and manage the geo-environmental and geological risks associated with the scheme. This will predominantly be in accordance with DMRB LA 109, Geology and Soils, 2019. The assessment of geo-environmental and geological risk will be presented in a Generic Quantitative Risk Assessment, along with the Preliminary Risk Assessment which will form technical appendices to the ES.

Proposed significance criteria

9.7.3 The significance criteria have been derived in general accordance with Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D Publication 66: Volume 1, 2001. The guidance was specifically developed to assess risks from land contamination for housing, but its principles are more widely applicable to other land uses. Each contaminant linkage has been assessed according to the probability and severity of likely impact.

9.7.4 Table 9.2 presents the classification of consequence (severity) that has been modified from R&D 66 and takes into account the potential severity of the hazard through the likely nature and extent of the likely contaminants of concern and the sensitivity of the receptor.

Table 9.2 – Clarification of consequence (severity) for geology and soils

Magnitude of Impact	Criteria Definition
Severe	Severe or irreversible moderate detrimental impact to human health. Severe temporary or irreversible reduction in the quality of a groundwater or surface water resource of local, regional or national importance. Irreversible or severe impacts on ecological systems. Irreversible detrimental effect to nationally important geological features and major strategic, mineral resource areas. Irreversible detrimental impact to building structure resulting in collapse or demolition.
Medium	Long term minor or short-term moderate detrimental impact to human health. Slightly or moderate, local-scale reduction in the quality of groundwater or surface water resources of local, regional or national importance, reversible with time. Reversible widespread reduction in the quality of groundwater or surface water resources used for commercial or industrial abstractions. Medium-term, reversible detrimental effect on animal or plant populations. Medium-term, reversible detrimental effect to nationally important geological feature and important mineral resource areas or Mineral Safeguarding Areas.
Mild	Short-term, minor detrimental impact to human health. Temporary, slight or moderate detrimental impact on the quality of groundwater or surface water resources that are used for or have the potential to be used for commercial or industrial abstractions. Short term, reversible detrimental impact on ecology, short-term, reversible detrimental effect to nationally important geological feature and Mineral Areas of Search / Consultation Areas.

Magnitude of Impact	Criteria Definition
Minor	No appreciable impact on human, animal or plant health, potable groundwater or surface water resources or geological feature of importance, or agricultural land quality or mineral resources.

9.7.5 Table 9.3 presents the classification of likelihood (probability) for the plausible contaminant linkages that are identified and takes into account the presence of the hazard and receptor and the integrity of the plausible pathway. The likelihood (probability) can be extrapolated to include other types of effects such as impacts on mineral resources, as presented in Table 9.3.

Table 9.3 – Classification of likelihood (probability) for geology and soils

Category	Definition
High likelihood	Harm, pollution or loss of attribute very likely in the short-term, almost inevitable in the long term, or there is already evidence of harm or pollution to the receptor.
Likely	Probable that harm, pollution or loss of attribute will occur but not inevitable.
Low likelihood	Possible that harm, pollution or loss of attribute could occur, but not certain.
Unlikely	Circumstances under which harm, pollution or loss of attribute would occur are improbable.

9.7.6 The level of risk for each plausible contaminant linkage including effects on mineral resources will be determined through the combination of severity and probability using the risk matrix presented in Table 9.4.

Table 9.4 – Classification of risk for geology and soils

Probability	Severe	Medium	Mild	Minor
High likelihood	Very High Risk	High Risk	Moderate Risk	Low Risk
Likely	High Risk	Moderate Risk	Moderate/ Low Risk	Low Risk

Probability	Severe	Medium	Mild	Minor
Low likelihood	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
Unlikely	Moderate/ Low Risk	Low Risk	Very Low Risk	Very Low Risk

9.7.7 The significance of effects on geology and soils (contamination and effects on mineral resources) will be determined by measuring the level of change (either adverse or beneficial) in the risk categorisations (defined in Table 9.4) for each plausible contaminant linkage, including the effects on mineral resources between the baseline conditions and either the construction or operational phase. The following terms will be used to define the significance of the effects identified:

- Major effect: An adverse or beneficial difference of four risk categorisations, where the scheme could be expected to have a very significant effect (either positive or negative) on receptors;
- Moderate effect: A difference of three risk categorisations, where the scheme could be expected to have a noticeable effect (either positive or negative) on receptors;
- Minor effect: A difference of one or two risk categorisations, where the proposed scheme could be expected to result in a small, barely noticeable effect (either positive or negative) on receptors; and,
- Negligible: No change in risk categorisation, where no discernible effect is expected as a result of the proposed scheme on receptors.

9.7.8 Criteria for the significance of effects on agricultural land as a result of development is detailed within the Table 9-5 below:

Table 9.5 – Significance criteria for effects on agricultural land

Significance criteria	Definition
Major adverse	Permanent loss or degradation of over 20ha of best and most versatile land (BMVL), or entire regional resources of BMVL (ALC Grades 1, 2, 3a)
Moderate adverse	Permanent loss or degradation of 5-20ha of BMVL, or large proportion of regional resource of BMVL.
Minor adverse	Permanent loss or degradation of <5ha of BMVL, or small proportion of regional resource of BMVL.
Negligible adverse	Permanent loss or degradation of non-BMVL.
No change	No observable impact in either direction, positive or negative.

Source: Significance criteria has been developed using professional judgement based on those presented within DMRB guidance.

9.8 Assessment assumptions and limitations

9.8.1 The baseline conditions have been obtained from WSP PRA and assumptions have been based on the information available at the time of writing. Further reviews including the scoping of a ground investigation are required to inform the assessment and preparation of the ES.

9.9 Factors and elements scoped in and out of further assessment

9.9.1 The factors to be scoped in for further assessment are summarised in Table 9.6.

Table 9.6 – Geology and soils elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Potential impact on human health receptors, construction workers and neighbouring site users	Construction	Yes	No	Potential for ground contamination to be experienced during construction and potential control of this material for environment/human effects. Construction works could disturb and exacerbate contamination or contribute a new source of pollution to the study area. The risk will need to be considered and mitigation measures applied.
Potential impact on controlled water receptors	Construction	Yes	No	Potential for ground and groundwater contamination. Construction works could disturb and exacerbate historical contamination or contribute a new source of pollution to the study area. Both the historical sources, and potential new sources introduced, could impact sensitive receptors including the surface waters and underlying aquifers unless mitigation measures are applied.
Mineral resources	Construction	Yes	No	Potential impact on mineral resources as a result of construction of the scheme.
Potential effect on slope stability	Construction	No	Yes	No significant slopes were noted during the walkover.

Element	Phase	Scoped In	Scoped Out	Justification
Potential impact on human health receptors (site users, adjacent site users and maintenance workers)	Operation	Yes	No	Without mitigation measures ground and groundwater contamination due to historical Site uses could impact future Site users.
Potential impact on controlled waters receptors	Operation	Yes	No	Without mitigation measures ground and groundwater contamination due to historical Site uses could impact controlled waters receptors.
Mineral resources	Operation	Yes	No	Without mitigation measures potential for contamination to impact Mineral Safeguarding Zones.

10 Materials and waste

10.1 Study area

10.1.1 The study areas that are applicable to the scheme are as defined in IEMA's Guide to Materials and Waste in Environmental Impact Assessment (April 2020) (IEMA (2020) Materials and Waste in Environmental Impact Assessment):

- The development study area comprises the extent of the scheme footprint and any areas required for temporary access, site compounds, working platforms and other enabling activities.
- The expansive study area extends to the availability of construction materials and the capacity of waste management facilities within the

UK and the East of England region (Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk and Suffolk).

10.2 Consultation

Consultation undertaken to date

10.2.1 No statutory consultation has been undertaken to date.

Proposed consultation

10.2.2 Statutory consultation with the local Minerals Planning Authority is anticipated in relation to the importance of mineral safeguard areas for silica sand, as well as sand and gravel deposits.

10.2.3 Consultation with the Waste Planning Authority is anticipated to discuss the likelihood of changes to materials management and landfill facilities.

10.3 Baseline conditions

Baseline data collected to date

10.3.1 This section describes the baseline material consumption and waste disposal for the existing land use and provides regional / national information and data in the context of which the assessment will be undertaken.

10.3.2 The current land use for the scheme is largely agricultural fields. The route for the scheme crosses Rectory Lane and Chequers Lane, and ties into the existing A10 and A47 road infrastructure via two new junctions.

Material resources

Materials currently required

10.3.3 The current land use is considered unlikely to consume construction materials. Therefore, the current use of resources is deemed negligible.

UK and regional perspective: availability of construction materials

10.3.4 Table 10.1 provides a summary of the availability of the main construction materials in East of England (Bedfordshire, Cambridgeshire, Essex,

Hertfordshire, Norfolk and Suffolk) and the UK, as required to deliver typical highways schemes.

Table 10-1 - Construction materials availability in the East of England and UK

Material type	East of England	UK
Sand and gravel Mineral Products Association, Profile of the UK Mineral Products Industry, 2020 Edition	13.7 million tonnes(Mt)	(no data)
Permitted crushed rock Natural England MAGIC mapping website	0.0Mt	(no data)
Primary aggregate (Comprises crushed rock, sand and gravel) Natural England MAGIC mapping website	(no data)	198.8Mt
Concrete blocks Department for Business, Energy & Industrial Strategy (2020) Monthly Bulletin of Building Materials and Components	3.1 million square meters (Mm^2) (Midlands)	9.1Mm^2
Recycled and secondary aggregate East of England Aggregates Working Party Annual Monitoring Report (2017) ,Natural England MAGIC mapping website	(no data)	71.0Mt (2018) (GB)
Ready-mix concrete Natural England MAGIC mapping website	1.5 million cubic meters (Mm^3)	24.7Mm^3

Material type	East of England	UK
Steel United Kingdom Steel Production I 1969-2020 Data I 2021-2022 Forecast I Historical	(no data)	7.2Mt
Asphalt Natural England MAGIC mapping website	2.5Mt	27.4Mt

10.3.5 The NCC interactive map of Mineral Safeguarding Areas (Norfolk County Council Interactive Map of Mineral Safeguarding Areas) indicates that the scheme is located over both silica sand, and sand and gravel deposits (as shown in the Environmental Constraints Plan for the scheme as presented in Appendix B). Further consideration and consultation with NCC on the importance of these resources is required.

10.3.6 There are no known peat resources (Natural England MAGIC mapping website) or active peat extractions (Defra, Basis of the UK BAP target for the reduction in use of peat in horticulture – SP0573 (2009)) within the primary study area.

10.3.7 The East of England has, in general, a slightly lower than average availability of some construction materials, for example the sales of permitted crushed rock are lower in the East of England in comparison to other UK regions. However, the availability of construction materials typically required for highways construction schemes in the East of England and across the UK, indicates that stocks / production / sales remain buoyant.

10.3.8 The East of England has, by comparison with the average for England (25%), an above average recycled content target for aggregate (31%) (Department for Communities and Local Government (2009). National and regional guidelines for aggregates).

10.3.9 Taking into account the above information, the sensitivity of materials required for the scheme is, on balance, assessed to be **low** (refer to Table F-1, Appendix F).

Site Arisings

Site arisings currently generated

10.3.10 The current land use is expected to generate negligible volumes of site arisings, limited to potential earthworks on agricultural land.

UK and regional perspective: transfer, recovery and recycling

10.3.11 Waste recovery facilities within the region have been assessed, to identify the availability of regional infrastructure and capacity for the transfer and recovery of construction, demolition and excavation wastes from the scheme. The availability of such infrastructure allows for the diversion of waste from landfill.

10.3.12 Defra data (Table 10.2) show that within England, the recovery rate for non-hazardous construction and demolition wastes have remained above 90% since 2010. This exceeds the EU target of 70%, which the UK must meet by 2020 (Defra (2019) UK Statistics on Waste) . This target excludes naturally occurring materials, specifically Category 17 05 04 in the List of Wastes, which is defined as non-hazardous soils and stones. (Directive 2008/98/EC of the European parliament and of the council of 19 November 2008 on waste and repealing certain directives. The European Parliament and the Council of the European Union (2008).)

Table 10.2 - Non-hazardous construction and demolition waste recovery in England (annual)

Year	Generation (Mt)	Recovery (Mt)	Recovery rate (%)
2010	53.6	49.4	92.2%
2011	54.9	50.8	92.5%
2012	50.5	46.4	92.0%
2013	51.7	47.6	92.0%
2014	55.9	51.7	92.4%
2015	57.7	53.3	92.3%
2016	59.6	55.0	92.1%

Note: Defra's 2019 update of the data in this table did not extend the data range beyond 2016.

10.3.13 No regional data for Construction, Demolition and excavation (CD&E) production or recovery rates are currently available for East of England.

10.3.14 Data in Figure 10.1 has been collated to show that trends for waste recovery in the region have generally risen steadily over the past 19 years (Environment Agency, Waste Data Interrogator (2019) Summary Tables for England). Whilst waste transfer data shows a gentle decline in recent years, the overall trend continues to be positive. Data in Figure 10.1 is for all waste types in the East of England and hence will include, but is not specific to, construction, demolition and excavation wastes.

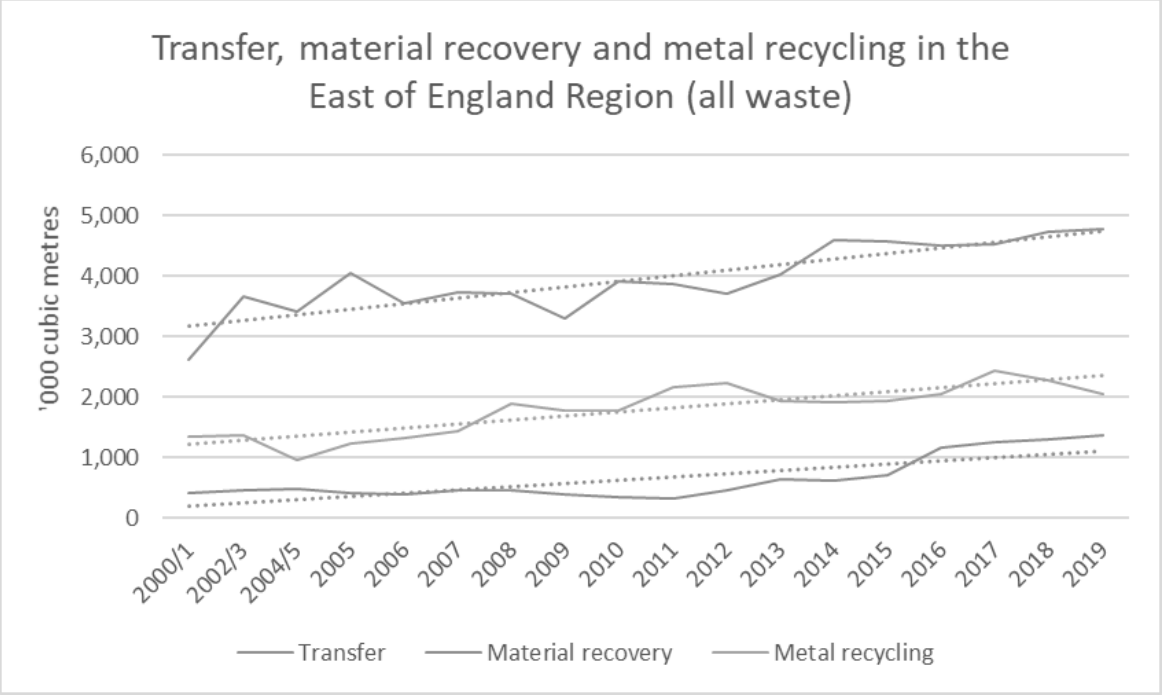

Figure 10.1 – Figure showing steady rise in transfer, materials recovery and metal recycling in the East of England (2000/1 – 2017)

10.3.15 Trends for transfer, recovery and metal recycling in the East of England indicate that there is likely to be regional infrastructure and capacity for the transfer and recovery for CD&E wastes from the scheme. Construction and demolition recovery trends across England (Figure 10.1) and data in Table 10-3 confirm this assertion.

Table 10.3 – Permitted waste recovering management sites in East of England (2019)

Waste recovery facility type	Number of sites
Incineration	17
Transfer	345
Treatment	388
Metal recovery	276
Use of waste	2
Total	**1,028**

Regional data for construction and demolition waste are presented in Figure 10-2, based on an analysis of publicly available information in the Waste Data Interrogator (Environment Agency, Waste Data Interrogator (2019) Waste Received).

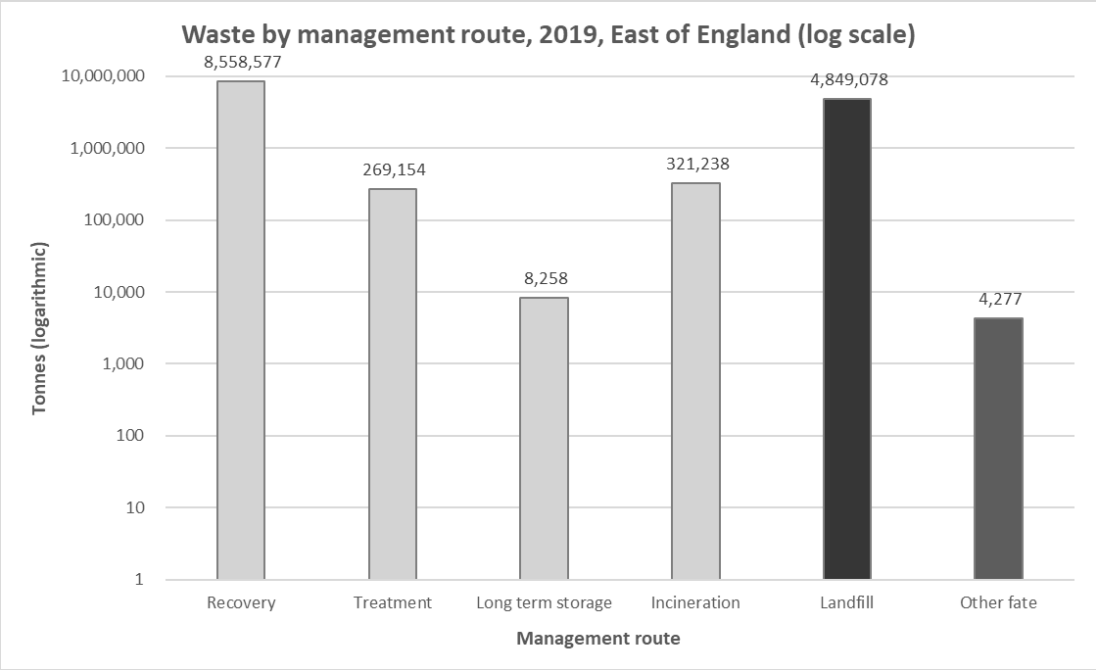

Figure 10.2 – Figure showing construction and demolition waste management by route for the East of England

10.3.16 Data presented in Figure 10-2 shows that the volume of waste recovered, including treatment and incineration, was more than double the volume of waste sent to landfill in the region in 2019. This is confirmed by data in Table 10-4 which show that in 2019, 65% of waste received in the

region was diverted from landfill through waste management and recovery methods. Data include the total waste received from both within the East of England region and from other regions in the UK.

Table 10.4 – Waste management routes for waste received in East of England (2019)

Waste Management Route	Inert and non-hazardous waste (tonnes)	Hazardous waste (tonnes)	Total waste (tonnes)	Percentage
Recovery	8,985,033	172,194	9,157,227	65%
Landfill	4,765,109	83,969	4,849,078	35%
Other fate	4,277	-	4,277	0%
Totals	13,754,419	256,164	14,010,582	100%

10.3.17 The charts and data presented in this section confirm the availability of waste management facilities in the region, that are expected, subject to data provision, to enable suitable recovery of site arisings generated by the scheme.

10.3.18 The availability of materials recovery infrastructure in the East of England, and across England, suggests that there is strong potential to divert from landfill site arisings generated by the scheme. The importance (positive value) of this infrastructure indicates there is a strong potential to maximise the reuse / recycling value of site arisings. This has the potential to materially influence impacts and effects from materials and waste.

Waste generation and Disposal

Waste currently generated and disposed of

10.3.19 The current land use (agricultural) is not expected to generate significant quantities of waste.

Regional perspective: remaining landfill capacity

10.3.20 Environment Agency data (Environment Agency, Remaining landfill capacity, England (2019)) confirm that at the end of 2019, 33 landfill sites in

the East of England were recorded as having 50.4Mm^3 (Million m^3) of remaining capacity. Data in Table 10.5 summarise this information by landfill type and show the change in capacity from 2018 to 2019.

Table 10.5 – Remaining landfill capacity in East of England

Landfill type	Remaining capacity in 2018 (m^3)	Remaining capacity in 2019 (m^3)	2018 to 2019 remaining capacity comparison
Hazardous (merchant and restricted)	0	0	0 (0%)
Inert	18,928,162	21,921,490	+3.0 (+15.8%)
Non-hazardous (including stable hazardous waste cells)	30,803,161	28,524,345	-2.3 (-7.4%)
Total	49,731,392	50,445,835	+0.7 (+1.4%)

10.3.21 As the data shows, no hazardous waste landfill sites are present within the East of England region. The Norfolk Minerals and Waste Development Framework states that since the ban on co-disposal of hazardous waste with non-hazardous waste to landfill in July 2004, there are no hazardous waste landfills in Norfolk. Furthermore, much of Norfolk is hydro-geologically unsuitable to locate a hazardous waste landfill site.

10.3.22 The Norfolk Minerals and Waste Development Framework, using data from 2009/10, indicates a shortfall of landfill capacity as follows:

- 690,000m^3 for non-hazardous waste;
- 2,059,000m^3 for inert waste.

10.3.23 The potential for developing stable non-reactive hazardous waste landfill (for asbestos and gypsum, for example), expanding an existing non-

hazardous landfill site and procuring a recovery waste plant are noted in the Norfolk Minerals and Waste Development Framework.

10.3.24 Baseline regional capacity is detailed in Figure 10-2. Simple statistical forecasting (using the Microsoft Excel forecasting function) has been used to demonstrate long term void capacity to the year of planned scheme completion (currently anticipated to be Summer 2026) in the absence of future provision.

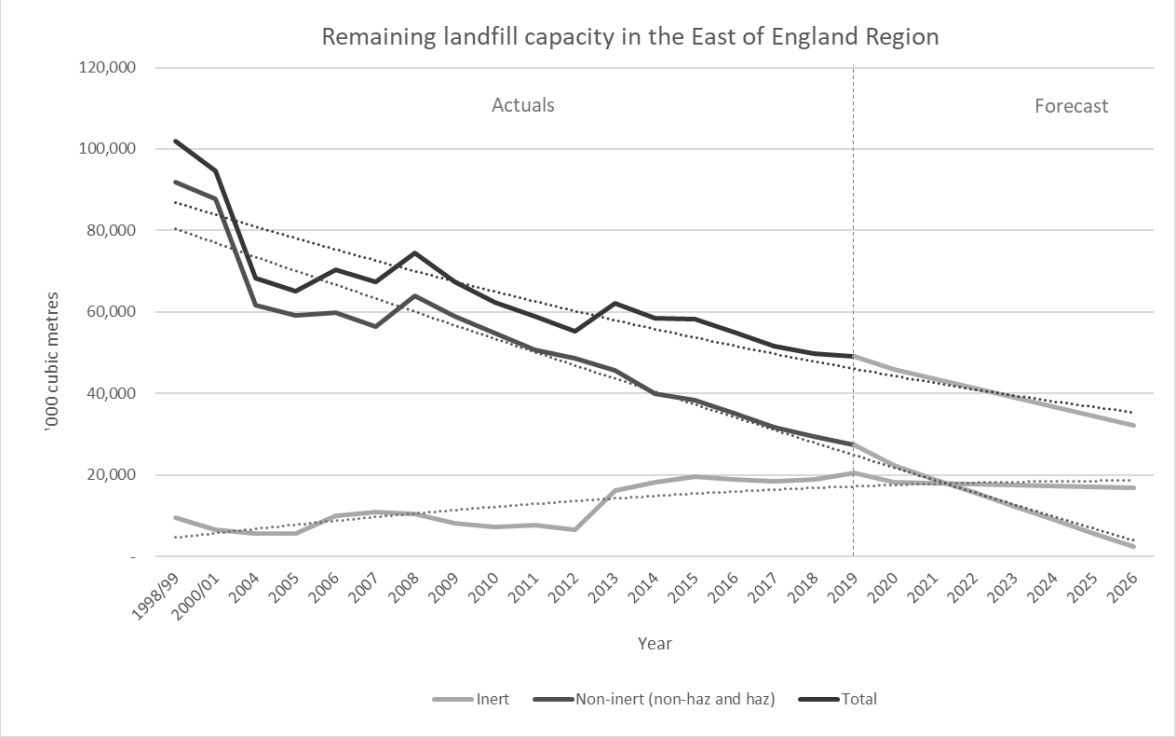

Figure 10.3 – Figure showing projected fall in landfill capacity in the East of England between 2019 and 2026

10.3.25 Baseline data indicates that total and non-inert landfill capacity is likely to become an increasingly sensitive receptor during the construction phase to the first full year of operation. Figure 10.3 shows that in the absences of future provision landfill capacity in the East of England from 2019 to 2026, is forecast to reduce. The percentage reduction by 2026 is set out in Table 10.6.

Table 10.6 – Forecast landfill capacity reduction in the East of England: 2019-2026

Landfill type	Forecast capacity reduction	Comments
Inert	-18%	None
Non-inert	-91%	Comprises hazardous and non-hazardous landfill, however noting that there is no remaining capacity for hazardous waste within the region.
Total	-34%	None

10.3.26 Due to the forecast percentage reduction in landfill capacity and in line with the criteria presented in Table F-1 of Appendix F, the sensitivity of different landfill capacity types over the lifetime of the scheme is assessed to be **very high** for inert and non-hazardous waste (over 10% reducing in forecast capacity); and **very high** for hazardous waste.

Proposed Baseline Data Collection

10.3.27 The baseline data used to inform the assessment is periodically updated. In the event that new data is released prior to the ES being drafted, the baseline data may require revision.

10.4 Mitigation measures

10.4.1 Mitigation measures to minimise virgin and other material resource consumption, and waste generation and disposal to landfill, are expected to be adopted to minimise any significant effects and ensure the scheme aligns with regional policy and legal requirements (for example, the Waste Hierarchy).

10.4.2 Typically, these 'industry standard' (basic) measures are incorporated as embedded mitigation during the scheme design and construction phase, and hence will be considered further within the ES.

10.5 Description of likely significant effects

10.5.1 In accordance with criteria set out in the IEMA's Guide to Materials and Waste in Environmental Impact Assessment (April 2020) (IEMA (2020) Materials and Waste in Environmental Impact Assessment), the following construction and operational phase effects are considered potentially significant:

- The consumption of large quantities of materials could have a potentially significant adverse effect on the environment through the depletion of natural resources; and
- Waste generated during construction of the scheme. The potential for significant effects from waste disposal is commensurate with a reduction in regional landfill void capacity; landfill capacity is considered an increasingly sensitive receptor in the UK.

10.5.2 Material and waste type and quantity data for the scheme are currently unavailable. Data summarising the anticipated imported materials, site arisings and waste generated for the construction phase will be assessed in the ES.

10.5.3 Operational demands on material consumption and waste generation are anticipated to be minimal, associated with periodic and minor repair and replacement activities. Whilst no data is available to quantify these assertions, professional judgement can be used to ascertain that the quantity of materials required and volumes of waste likely to be generated will have neither adverse impacts or effects on regional resource availability or landfill capacity. As such, the effects during operation are considered not significant and are expected to be scoped out during environmental assessment.

10.6 Enhancement measures

10.6.1 No enhancement measures have been identified at this stage.

10.7 Proposed assessment methodology

10.7.1 IEMA's Guide to Materials and Waste in Environmental Impact Assessment (April 2020) will be used to assess the potential impacts and effects from the scheme, using the process and significance criteria it sets out. It is anticipated that Method W1 (Void Capacity, as detailed in the IEMA Guide) will be used to best reflect the scale and nature of the scheme.

10.7.2 In accordance with the IEMA guidance, the assessment will be a quantitative exercise that aims to identify the:

- type and volume of materials to be consumed by the scheme, including details of any recycled materials content;
- type and volume of waste to be generated by the scheme, with details of planned recovery and / or disposal method (for example on-site reuse, off-site recycling, disposal to landfill);
- cut and fill balance; and
- details of any materials to be specified, where sustainability credentials (particularly those that improve resource efficiency) afford performance beyond expected industry standards.

10.7.3 The sensitivity of materials relates to the regional (and where justified, national) availability and type of resources to be consumed by the scheme. The sensitivity of waste relates to the availability of regional (and where appropriate, national) landfill void capacity, in the absence of the scheme and future provision.

10.7.4 The magnitude of impacts from the scheme that will be considered in the assessment include:

- Anticipated reductions in availability (stocks, production and/or sales) of materials regionally and nationally; and
- Anticipated reductions in the landfill void capacity of regional and national infrastructure.

10.7.5 The likely types and estimated quantities of material resources required (including site arisings generated) for the scheme will be assessed. Impacts and effects will be evaluated using regional (and where justified, national) materials availability data, where information is available.

10.7.6 Among other criteria, the assessment will consider the contribution of alternative sources of aggregate (secondary products and recycled aggregates) as part of the scheme construction. Where aggregates data are not available, assumptions will be made based on guidelines for aggregates provision on England (for the period 2005 – 2020) as set out in the *National and Regional Guidelines for Aggregates Provision in England* (National and regional guidelines for aggregates provision in England 2005 to 2020. Department for Communities and Local Government (2009).)

10.7.7 The likely types and estimated quantities of waste to be generated by the scheme will be assessed. Impacts will be evaluated against the capacity of regional (or if appropriate, national) landfill infrastructure.

Proposed significance criteria

10.7.8 The significance criteria set out in IEMA's Guide to Materials and Waste in Environmental Impact Assessment (April 2020) (IEMA (2020) Materials and Waste in Environmental Impact Assessment) will be used. For the purposes of this assessment, Method W1 (landfill void capacity), as set out in the IEMA guidance, will be applied.

10.7.9 The assessment will consider the nature of impacts (adverse/beneficial, permanent/temporary, direct/indirect) from material resource consumption and waste generated and disposed of and use professional judgement to determine the significance of effect. Significance criteria are provided in Appendix F.

10.8 Assessment assumptions and limitations

10.8.1 Data for material resource availability, landfill capacity and waste recovery are only updated periodically. The most up to date sources of available information have been used at the time of writing.

Materials

10.8.2 The assessment of material resources will be based upon the validity of the collated information, regarding the materials that are expected to be consumed during the 'in scope' lifecycle phases of the scheme.

10.8.3 Baseline data and information for the assessment will use the most recent available data, however this is typically only available to 2019 (unless stated otherwise).

10.8.4 A lifecycle assessment (including embodied carbon and water) of materials will not be included in the ES as the effort and resources required are deemed disproportionate to the benefit, they would offer the assessment.

Waste

10.8.5 The assessment of impacts on landfill void capacity will be based upon the validity of the collated information, regarding the waste generated and disposed by the scheme.

10.8.6 UK landfill operators can claim commercial confidentiality for their data; data for sites with a commercial confidentiality in place are therefore unavailable for analysis. It is not anticipated that any lack of data in this context will significantly affect the results of the assessment presented in the ES.

10.8.7 Baseline data and information for the assessment will use the most recent available data, however this is typically only available to 2019 (unless stated otherwise).

10.9 Factors and elements scoped in and out of further assessment

10.9.1 The factors to be scoped in for further assessment are summarised in Table 10.7

Table 10.7 – Materials and waste elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Material resources required	Construction	Yes	No	There is currently insufficient information available to determine the potential significance of effects as a result of material required for the scheme. Assessment will identify opportunities for re-use within the scheme where appropriate. Further assessment of material types and quantities, cut and fill balance and mitigation measures, will be included in the ES.
Waste generation	Construction	Yes	No	There is currently insufficient information available to determine the potential significance of effects as a result of waste production. Types and volumes of waste, assessment of remaining landfill capacity locally, on-site storage, potential disposal/treatment/re-use of waste and assessment of mitigation measures included in the scheme will be included within the ES.

Element	Phase	Scoped In	Scoped Out	Justification
Material resources required	Operation	No	Yes	The quantity of material resources required, during the operational phase (for example routine maintenance and repairs) is considered negligible and is not expected to have significant adverse effects.
Waste generation	Operation	No	Yes	The quantity of waste generated during the operational phase (e.g. routine maintenance and repairs) is considered negligible and not expected to have significant adverse effects.

11 Climate

11.1 Introduction

11.1.1 This chapter considers the scheme's impact on climate, and its vulnerability to climate change during construction and operation, and any potential significant effects resulting from that. It sets out the methodology used to assess climate and identifies those impacts that can be scoped out of the EIA.

11.1.2 As such, this chapter considers the impacts and effects of the scheme in terms of:

- The contribution to climate change: an assessment of greenhouse gas (GHG) emissions generated by the scheme; and
- The vulnerability of the scheme itself to climate change (i.e. climate change resilience and adaptation aspects).

11.1.3 The chapter is divided into the two aspects above and describes for each the assessment methodology and relevant baseline conditions. These have been used to identify the aspects to be scoped in or out of further assessment.

Greenhouse Gases

11.2 Study area

11.2.1 The Greenhouse Gases (GHG) assessment is not restricted by geographical area but instead includes any increase or decrease in emissions as a result of the scheme, wherever that may be. This includes:

- Construction emissions in the area of the scheme footprint but also related to the transport of materials to and from the site and their manufacture (this may be far from the scheme location - for example emissions due to the manufacture of steel);
- Operational emissions (increase or reduction in emissions) which result from the end-users of the scheme and any shifts in transport modes/patterns which may occur. Such emissions include those for traffic using the scheme as well as the surrounding regional road network.

11.3 Consultation

Consultation undertaken to date

11.3.1 No statutory consultation has been undertaken to date.

Proposed consultation

11.3.2 No statutory consultation is proposed.

11.4 Baseline conditions

Existing baseline

11.4.1 In the baseline (Do Minimum) scenario, GHG emissions occur constantly and widely as a result of human and natural activity including energy consumption (fuel, power), industrial processes, land use and land use change. The GHG assessment will only consider instances in which the scheme results in additional or avoided emissions in comparison to the baseline scenario and its assumed evolution. The baseline conditions therefore focus on those

emissions sources subject to change between the baseline scenarios without scheme and with scheme.

11.4.2 However, transport emissions from 2018 within King's Lynn and West Norfolk, Norfolk and nationally are presented in Table 11.1 for context (Department for Business, Energy & Industrial Strategy (2020), UK local authority and regional CO2 emissions national statistics:2005-2018).

Table 11.1 – Transport emissions sources (2018) for King's Lynn and West Norfolk, Norfolk and the UK

Year	King's Lynn and West Norfolk ($ktCO_2$)	Norfolk ($ktCO_2$)	National ($ktCO_2$)
I. Road Transport (A roads)	215	1,061	54,229
J. Road Transport (Motorways)	n/a	n/a	29,936
K. Road Transport (Minor roads)	162	776	38,486
L. Diesel Railways	0.1	14	1,900
M. Transport Other	12	136	2,249
Transport Total	390	1,986	126,801

11.4.3 The current land use for the scheme is dominated by agricultural land. The scheme corridor crosses Rectory Lane and Chequers Lane, and ties into the existing A10 and A47 road infrastructure.

11.4.4 The baseline scenario involves no construction activities, and therefore the construction baseline scenario is zero emissions.

Proposed baseline data collection

11.4.5 It is proposed that end user emissions baseline data is produced based on the scheme traffic model. The model will be used to produce total end-user GHG emissions from traffic flows in the 'do nothing' scenario. These will be modelled in line with DMRB, Volume 11, Section 3, Part 1 Air Quality; HA 207/07 (Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1

Air Quality; HA 207/07 (2017)). The modelling includes the total GHG emissions for vehicles covered by the traffic model, covering the road network in the area of the scheme and its surroundings. The end-user emissions baseline will be reported in the ES.

11.4.6 The operation and management of the existing assets under the baseline scenario are likely to require a small number of components (for example, light bulbs and signage) as well as some bulk material (cement, concrete, sand and gravel) for minor works and repairs of the highway and ancillary infrastructure. These materials will have embodied emissions associated with them, and the installation of these materials will result in emissions due to the transport of these materials, and plant use. These baseline emissions are expected to be negligible, and as such will not be quantified.

11.5 Mitigation measures

Design/ construction

11.5.1 The magnitude of GHG emissions associated with the design and construction phase of the scheme can be minimised by, amongst others:

- Design optimisation to reflect the carbon reduction hierarchy (detailed below and found in clause 6.1.4 of BSI (2016) Publicly Available Specifications:2080 Carbon management in Infrastructure (BSI (2016) PAS 2080 Carbon Management in Infrastructure)) (hereafter referred to as PAS 2080);
- Reduce the elements required for the scheme;
- Reduce the requirement for construction materials;
- Substitute construction elements for lower-carbon alternatives (e.g. using low temperature asphalt);
- Use efficient construction processes, such as design for manufacture and assembly.

- Specify materials and products with reduced embodied GHG emissions including through material substitution, recycled or secondary content and from renewable sources;
- Designing, specifying and constructing the scheme with a view to maximising the operational lifespan and minimising the need for maintenance and refurbishment (and all associated emissions);
- Designing, specifying and constructing the scheme with a view to maximising the potential for reuse and recycling of materials/elements at the end-of-life stage;
- Specifying high efficiency mechanical and electrical equipment such as lighting and telecoms;
- Minimising the quantities of materials required to construct the scheme;
- Maximising the use of construction materials and products with recycled or secondary and low carbon content, from renewable sources, and offering sustainability benefit;
- Using locally-sourced materials where available and practicable to minimise the distance materials are transported from source to site;
- Using more efficient construction plant and delivery vehicles, and/or those powered by electricity from alternative/lower carbon fuels; and
- Using innovative construction methods to reduce plant use.

Operation

11.5.2 The magnitude of GHG emissions associated with the operational phase of the scheme can be minimised by, amongst others:

- Specifying high efficiency mechanical and electrical equipment such as lighting and telecoms;
- Operating, maintaining and refurbishing the scheme using best-practice efficient approaches and equipment;

- Incorporating onsite renewable electricity production;
- Ensuring designs are focussed upon reduction of emissions from end-user vehicle movement (traffic) for example by providing the conditions for efficient low-carbon vehicles and for non-vehicular (active) transport; and
- Considering use of tree planting as part of the scheme in order to sequester carbon.

11.6 Description of likely significant effects

11.6.1 The potential sources of GHG emissions associated with the scheme are identified in Table 11.2.

Table 11.2 – key emissions sources during the scheme lifespan

Lifestyle Stage (as per PAS 2080[14])	Lifestyle State (as per PAS 2080[14])	Potential Sources of Emissions (Not exhaustive)
Construction	Product stage (manufacture and transport of raw materials to suppliers) A1-3	Embodied emissions associated with extraction and manufacturing of the required raw materials
Construction	Transport of materials to site A4	Emissions from fuel and electricity used in vehicles transporting materials to site
Construction	Plant and equipment use during construction A5	Emissions from fuel and electricity used in plant and equipment on site
Construction	Transport of waste A5	Emissions from fuel/energy used in vehicles transporting materials away from site
Construction	Disposal of waste A5	Emissions from the final disposal of waste materials

Lifestyle Stage (as per PAS 2080[14])	Lifestyle State (as per PAS 2080[14])	Potential Sources of Emissions (Not exhaustive)
Construction	Land use, land use change and forestry A5	Change in emissions associated with the clearance and disposal of biomass due to the scheme
Operation	Operation B1	Electricity used for lighting
Operation	Maintenance, repair, replacement, refurbishment B2-5	Embodied emissions and emissions from transport and plant associated with maintenance, repair, replacement and refurbishment
Operation	Land use, land use change and forestry B8	Change in emissions associated with the existence of the scheme hindering or promoting the sequestration of carbon dioxide into biomass
Operation	End-user emissions (regional traffic flows) traffic B9/D	Vehicles using highways infrastructure affected by the scheme
End of life	Decommissioning process C1	Emissions from decommissioning work (ie fuel/electricity)
End of life	Transport and disposal of materials C2-4	Emissions sources as fuel/energy consumption from transport of materials to disposal sites or recovery

11.6.2 The impact of GHG emissions relates to their contribution to global warming and climate change. These impacts are global and cumulative in nature, with every tonne of GHGs contributing to impacts on natural and human systems. GHG emissions result in the same global effects wherever and whenever they occur and, therefore, the sensitivity of different human and natural receptors is not considered. The magnitude of emissions associated with the scheme will not be quantified until the ES is produced, and as such the impact of the scheme on the climate is not currently known.

11.7 Enhancement measures

11.7.1 By utilising the mitigation measures for the scheme design, as well as during construction and operation, impacts on GHG emissions can be reduced.

11.8 Proposed assessment methodology

11.8.1 The assessment will consider the likely magnitude of GHG emissions (or avoided emissions) in comparison to the baseline scenario without the scheme. It will consider emissions throughout the lifecycle of the scheme including:

- Construction stage – for example the embodied emissions associated with materials, transportation of materials to site and waste/arisings from site, and the construction process; and
- Operation - for example emissions (or avoided emissions) from end-user vehicles.

11.8.2 For all lifecycle stages and sub-stages of the scheme, the assessment will include the following:

- Collection of available data/information on the scale of GHG emitting activities (for example tonnes concrete, litres of fuel, kWh electricity) for the baseline scenario and for the scheme. In each case this will cover the design life of the scheme, assumed to be 60 years; and
- Calculation of the GHG emissions by applying a suitable emissions factor (tCO_2e per unit of emissions generating activity).

Construction

11.8.3 Emissions calculations from the construction stage will be completed within an industry recognised carbon calculation tool which focuses on emissions throughout the project lifecycle. For this assessment, the Highways England's carbon tool (Carbon emissions calculation tool - National Highways) will be used. Values will be reported as tonnes of carbon dioxide equivalents (tCO_2e).

Operation

11.8.4 Traffic emissions will be quantified in line with DMRB, Volume 11, Section 3, Part 1 Air Quality; HA 207/07 (Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 Air Quality; HA 207/07 (2017)). A detailed assessment approach will be used based on publicly available information from the Department of Transport. Values will be reported as tonnes of carbon dioxide equivalents (tCO_2e).

11.8.5 Operational emissions from replacement activities (such as re-surfacing), will use the Highways England carbon tool, as explained above.

Proposed significance criteria

11.8.6 In line with the National Networks National Policy Statement (NNNPS), significance of GHG impacts is assessed by comparing estimated GHG emissions arising from the scheme with the respective UK carbon budget (Table 11.3), which have been set by the UK Government covering 2018 to 2032.

11.8.7 The Sixth Carbon Budget report was released by the Committee on Climate Change (CCC) in December 2020, which proposes the limit on allowed UK territorial GHG emissions over the period 2033 to 2037. The CCC advise the 'Balanced Net Zero Pathway', reducing emissions by 2035 to 78% below 1990 levels. However, it is yet to be legislated (it must be by the middle of 2021).

11.8.8 There are no agreed thresholds for what level of GHG emissions is considered significant in an EIA context. As such the magnitude of emissions, in conjunction with guidance from IEMA[15] will inform professional judgement of significance.

Table 11.3 – UK carbon budgets

Carbon Budget Period	UK Carbon Budget
Third: 2018-2022	2,544 $MtCO_2e$
Fourth: 2023-2027	1,950 $MtCO_2e$

Carbon Budget Period	UK Carbon Budget
Fifth: 2028-2032	1,725 $MtCO_2e$

Source: Institute of Environmental Management and Assessment

11.9 Assessment assumptions and Limitations

11.9.1 The following assessment assumptions and limitations are envisaged:

- Depending on the available information at the time of the assessment, there may be some uncertainty regarding the types and quantities of materials to be used in construction;
- The assessment of significance will be based, in part, on professional judgement;
- There will be some uncertainty regarding forecast traffic modelling data; and
- Some small emissions sources have been excluded as emissions from these sources are not considered likely to be large and therefore not material to the assessment.

11.10 Factors and elements scoped in and out of further assessment

11.10.1 Based on the emissions sources identified in Table 11.2 and using guidance from the Institute of Environmental Management and Assessment (IEMA) (IEMA (2017) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance), professional judgement has been used to determine which sources to scope out from further consideration in the EIA. A summary of this proposed scope is presented in Table 11.4.

Table 11.4 – Greenhouse gases elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Product stage (manufacture and transport of raw materials to suppliers) A1-3	Construction	Yes	No	Raw materials required for the scheme will result in embodied emissions and have the potential to be large.
Transport of materials to site A4	Construction	Yes	No	Construction stage emissions from fuel / energy consumption due to the delivery of material to site have the potential to be large.
Plant and equipment used during construction (A5)	Construction	Yes	No	Fuel / energy consumption of plant and equipment used during construction would generate GHG emissions.
Transport of waste A5	Construction	Yes	No	Emissions from fuel / energy consumption due to the transport of waste materials, particularly fill, have the potential to be large.
Replacement B4	Operation	Yes	No	The replacement and refurbishment of the scheme would release emissions.
End-user emissions (regional traffic flows) - traffic B9/D	Operation	Yes	No	Changes to regional traffic flows are expected and this has the potential to result in a large change in GHG emissions.

Element	Phase	Scoped In	Scoped Out	Justification
Disposal of waste A5	Construction	No	Yes	Emissions from the disposal of waste are unlikely to be large.
Land use, land use change and forestry A5	Construction	No	Yes	Emissions from the disposal of biomass, are not expected to be material as the scheme area is currently agricultural land.
Maintenance, repair and refurbishment B2, B3 & B5	Operation	No	Yes	The scheme is considered to require infrequent, if any, maintenance, repair and refurbishment, therefore subsequent emissions sources are not considered to be large.
Operational Energy Use B1	Operation	Yes	No	The dual section of the A47, the approaches to the Hardwick Interchange and the roundabout off the A47 onto the housing access road will be lit.
Land use, land use change and forestry B8	Operation	No	Yes	The reduction in carbon sequestration due to the scheme is not considered to be material as the scheme area is currently agricultural land.

Element	Phase	Scoped In	Scoped Out	Justification
Decommissioning process C1 (end of life)	Operation (end of life)	No	Yes	Expected timescales for decommissioning are so far into the future that there is insufficient certainty about the likelihood, type or scale of emissions activity to determine their likely magnitude, even if they take place at all. As such these emissions sources will not be considered.

Climate vulnerability

11.10.2 This scoping assessment has been undertaken using an approach based on the following guidance documents, experience and professional judgement:

- Institute of Environmental Assessment & Management (IEMA) EIA Guide to Climate Change Resilience and Adaptation (IEMA - IEMA EIA Guide to: Climate Change Resilience and Adaptation (2020)); and
- Highways England's DMRB LA 114 Climate (LA 114 - Climate).

11.11 Study area

11.11.1 The study area for climate resilience refers to the impact of climate on the scheme (rather than the impact of the scheme on the environment). As such, the study area is the proposed boundary for the scheme and the wider area within the scheme vicinity.

11.11.2 The identification of study area when considering climate vulnerability relates to the choice of climate projections on which to base the vulnerability assessment, in terms of spatial and temporal resolution, as well as choice of emissions scenario.

11.12 Consultation

Consultation undertaken to date

11.12.1 No statutory consultation has been undertaken to date.

Proposed consultation

11.12.2 No statutory consultation is proposed.

11.13 Baseline Conditions

11.13.1 The EIA Guide to Climate Change Resilience and Adaptation and DMRB LA114 identifies the need for the baseline to consider:

- The current climate baseline (defined by historic climate conditions) to provide an indication of past vulnerability; and
- The future climate baseline (short term extremes and long-term variation) to assess a project's vulnerability to climate change.

Historic climate

11.13.2 The scheme is located in the East of England climatic region which comprises the counties of Bedfordshire, Cambridgeshire, Norfolk, Suffolk, Lincolnshire, the East Riding of Yorkshire and parts of Essex and Hertfordshire. This region has a warm dry climate compared to the UK average.

11.13.3 Sea level around the UK rose by about 1mm/year in the 20th century, corrected for land movement (Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK). At Cromer (the nearest tide gauge site to the scheme), mean sea level has increased by approximately 145mm over the period 1989-2015 (Permanent Service for Mean Sea Level (PSMSL) (2019), Cromer). The East of England region is drier than the UK average (Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK), with the lowest monthly rainfall in February and March, and highest in October. The region is

also warmer than the UK average (Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK), with July being the warmest month and January being the coldest month. The region is less windy than the UK average (Jenkins, G.J., Perry, M.C., and Prior, M.J. (2008). The climate of the United Kingdom and recent trends. Met Office Hadley Centre, Exeter, UK), with highest wind speeds occurring in January and lowest wind speeds occurring in August. Average daily solar irradiance in the region of the scheme over the period 1961 to 1980 is in the region of 106 watts per meters squared (Wm^2) (Burnett, D., Barbour, E. and Harrison, G.P. (2014) The UK solar energy resource and the impact of climate change. Renewable Energy, 71, 333-343).

Future climate

11.13.4 Climate projections have been obtained from the Met Office UK Climate Projections 2018 for the 25km grid square containing the scheme. Projections are presented for the 10^{th}, 50^{th} and 90^{th} percentile based on a baseline of 1981-2010. The 50^{th} percentile is the 'central estimate' across the models and is considered the level for which as much evidence points to a lower outcome as a higher one. The 10^{th} and 90^{th} centile values are indicative of the lower and upper range of the projected values. The emissions scenarios within the UKCP18 projections are referred to as Representative Concentration Pathways (RCP), for which RCP 8.5 (equivalent to a high emissions scenario) has been used to inform the projections (Representative Concentration Pathways specify the concentrations of greenhouse gases that would result in target amounts of radiative forcing at the top of the atmosphere by 2100, relative to preindustrial levels. Four forcing levels have been set: 2.6, 4.5, 6.0 and 8.5 W/m2. These create four RCPs that are used in UKCP18; RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5.). This is representative of a reasonable worst-case scenario.

11.13.5 The future baseline has been presented for the 2020s (2010-2039), the 2050s (2039-2069) and 2080s (2070-2099) to identify the anticipated climate conditions over the construction and life of the scheme's key components.

11.13.6 Projected changes in precipitation and temperature under RCP8.5 are presented in Table 11.5.

Table 11.5 – Projected change in mean summer and winter precipitation (%) and temperature (°C) for the 2020s, 2050s and 2080s under RCP8.5

Season	Time slice	10TH Percentile change in Precipitation	50TH Percentile change in Precipitation	90TH Percentile change in Precipitation	10TH Percentile change in Temperature	50TH Percentile change in Temperature	90TH Percentile change in Temperature
Summer	2020s	-22%	-6%	9%	0.3°C	0.9°C	1.6°C
Summer	2050s	-43%	-19%	3%	0.9°C	2.3°C	3.8°C
Summer	2080s	-60%	-32%	-2%	2.1°C	4.4°C	7.0°C
Winter	2020s	-4%	3%	10%	-0.1°C	0.7°C	1.4°C
Winter	2050s	-4%	7%	19%	0.4°C	1.7°C	2.9°C
Winter	2080s	0%	17%	36%	1.1°C	3.1°C	5.1°C

11.13.7 Climate change is also likely to lead to the following:

- More rainfall falling during 'intense' events, particularly in winter. UKCP18 indicates an increase in precipitation intensity on wet days in winter across the UK;
- Rising winter temperatures are likely to reduce the amount of precipitation that falls as snow in winter; and
- Increase in frequency of extreme weather events such as storms and heatwaves.

11.14 Mitigation measures

11.14.1 Examples of design and mitigation measures to reduce vulnerability to impacts of climate changes during construction and operation of the scheme include:

Construction

- Ensure site compound drainage has sufficient capacity to cope with heavy rainfall events;
- Store chemicals, hazardous materials and plant on high ground or protecting with bunds / flood barriers;
- Cover spoil and material heaps during periods of high rainfall or high winds;
- Spray spoil and material heaps during dry periods to reduce dust;
- Review wind speed before commencing work at height;
- Cease work at height during storms;
- Regularly inspect materials stockpiles and structures with additional inspections during and following extreme weather events (e.g. floods, heatwaves, storms);

- Provide adequate rest, shade and PPE (e.g. hats and suncream) for workforce during periods of high temperature and high solar radiation;
- Ensure welfare facilities are available and sufficiently cool;
- Adjust programme of activities or schedule daily working time to account for weather conditions; and
- Build additional contingency into the programme.

Operation

- Design drainage infrastructure and road surface to take account of projected change in rainfall;
- Use a series of detention basins to slow down the movement of surface water;
- Regular clearing and maintenance of drainage infrastructure to prevent blockage;
- Slope stabilisation measures including the use of vegetation to bind soils. Drought-resistant vegetation species should be specified to ensure they will be suitable for future climate conditions;
- Consider projections of extreme temperature when specifying materials e.g. use harder binders in asphalt, alter concrete mix. Re-consider choice of materials when repair or replacement is necessary;
- Take account of projected temperature increases in design of expansion joints;
- Regular inspection of drainage infrastructure, materials and structures to identify any deterioration;
- Additional inspection of earthworks and structures following extreme weather events (e.g. floods, heatwaves, drought, storm). Bring forward repair/replacement if necessary;
- Take account of projected wind speed in viaduct design;

- Enforce speed restrictions during high winds;
- More frequent vegetation management on verges;
- Back-up power source for electrical equipment and signalling; and
- Appropriate hazard and warning signage along the roadside.

11.15 Description of likely significant effects

11.15.1 The receptor for the climate resilience assessment is the scheme. The vulnerability of the scheme to climate variables depends on the typical sensitivity of receptors to climate variables and the exposure of receptors to projected change in climate variables.

11.15.2 Based on the relevant guidance (Standards Australia (2013) Climate Change Adaptation for settlements and infrastructure – a risk-based approach. SAI Global Limited), the climate variables which the scheme components are typically sensitive to are shown in Table 11.6. Cells containing a tick mark indicate where the climate variable are relevant to the scheme components; the grey shaded cells are components which are not relevant.

Table 11.6 – Sensitivity of scheme components

Scheme element	**Sea variable**	**Sea variable**	**Sea variable**	**Sea variable**	**Precipitation variable**	**Precipitation variable**	**Precipitation variable**	**Temperature variable**	**Temperature variable**	**Temperature variable**	**Wind variable**	**Wind variable**	**Relative Humidity variable**	**Relative Humidity variable**	**Soil variable**	**Soil variable**	**Soil variable**	**Soil variable**
Scheme element	Sea level rise	Storm surge and storm tide	Surface temperature	Currents and waves	Change in annual average	Drought	Extreme precipitation events	Changes in annual average	Extreme temperature events	Solar radiation	Gales and extreme wind events	Storms (snow, lightning, hail)	Changes in annual average	Evaporation	Soil moisture	Salinity/pH	Runoff	Soil stability
Construction	No	No	No	No	No	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	No	No	No
Operation	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes

11.15.3 Based on the information identified in the baseline, literature review and expert opinion, Table 11.7 outlines the climate sensitivity of the scheme.

Table 11.7 – Sensitivity assessment

Climate variable	Climate variable	Sensitivity of scheme components during Construction phase	Sensitivity of scheme components during Operation phase
Sea	Sea level rise	Medium	Medium
Sea	Storm surge and storm tide	Medium	High
Precipitation	Changes in annual average	Low	Medium
Precipitation	Drought	Medium	Medium
Precipitation	Extreme precipitation events	Medium	High
Temperature	Change in annual average	Low	Medium
Temperature	Extreme temperature events	Medium	High
Temperature	Solar radiation	Low	Low
Wind	Gales and high winds	Medium	High
Wind	Storms	Medium	High
Soils	Soil moisture	Medium	Medium
Soils	Runoff	Medium	Medium
Soils	Soil stability	Medium	High

11.15.4 Based on the future climate projections, Table 11.8 summarises the exposure of the scheme to change in climate variables.

Table 11.8 – Exposure assessment

Climate variable	Climate variable	Exposure in 2020s	Exposure in 2050s	Exposure in 2080s
Sea	Sea level rise	Low	Medium	High
Sea	Storm surge and storm tide	Low	Medium	High
Precipitation	Change in annual average	Low	Medium	Medium
Precipitation	Drought	Medium	High	High
Precipitation	Extreme precipitation events (flooding)	Medium	High	High
Temperature	Changes in annual average	Low	Medium	Medium
Temperature	Extreme temperature events	Medium	Medium	Medium
Temperature	Solar radiation	Low	Low	Low
Wind	Gales and extreme wind events	Medium	Medium	Medium
Wind	Storms (hail, lightning)	Medium	Medium	Medium
Soils	Soil moisture	Low	Medium	Medium
Soils	Runoff	Low	Medium	Medium
Soils	Soil stability	Low	Medium	Medium

11.15.5 The sensitivity and exposure analyses are combined to provide an overall assessment of vulnerability of the scheme. For each element, the vulnerability assessment is determined from the combination of the sensitivity and exposure categorisation, using the matrix shown in Table 11.9 and based on the following scale:

- High: High climate sensitivity or exposure;
- Moderate: Moderate climate sensitivity or exposure; and
- Low: No significant climate sensitivity or exposure.

11.15.6 This is a qualitative assessment informed by expert opinion and supporting literature. The output of the vulnerability assessment is a list of

climate variables which will be scoped into further assessment. 'Low' vulnerabilities are scoped out of further assessment, whilst 'High' and selected 'Moderate' vulnerabilities are scoped in.

Table 11.9 – Vulnerability matrix

Sensitivity	Low exposure	Medium exposure	High exposure
Low	Low vulnerability	Low vulnerability	Low vulnerability
Medium	Low vulnerability	Medium vulnerability	Medium vulnerability
High	Low vulnerability	Medium vulnerability	High vulnerability

11.15.7 High and Medium vulnerabilities are considered to be the potential effects which will be scoped in and assessed in more detail at the next stage of the assessment. Table 11.10 and 11-11 present the assessment of vulnerability for the construction and operation of the scheme.

Table 11.10 – Vulnerability assessment: construction

Variable	Variable	Sensitivity	Exposure	Vulnerability
Sea	Sea level rise	Medium	Low	Low
Sea	Storm surge and storm tide	Medium	Low	Low
Precipitation	Change in annual average	Low	Low	Low
Precipitation	Drought	Medium	Medium	Medium
Precipitation	Extreme precipitation events	Medium	Medium	Medium
Temperature	Change in annual average	Low	Low	Low
Temperature	Extreme temperature events	Medium	Medium	Medium
Temperature	Solar radiation	Low	Low	Low

Variable	Variable	Sensitivity	Exposure	Vulnerability
Wind	Gales and extreme wind events	Medium	Medium	Medium
Wind	Storms (snow, lightening, hail)	Medium	Medium	Medium
Soils	Soil moisture	Medium	Low	Low
Soils	Runoff	Medium	Low	Low
Soils	Soil stability	Medium	Low	Low

Table 11.11 – Vulnerability assessment: operation

Variable	Variable	Sensitivity	Exposure*	Vulnerability
Sea	Sea level rise	Medium	High	Medium
Sea	Storm surge and storm tide	High	High	High
Precipitation	Change in annual average	Medium	Medium	Medium
Precipitation	Drought	Medium	High	Medium
Precipitation	Extreme precipitation events	High	High	High
Temperature	Change in annual average	Medium	Medium	Medium
Temperature	Extreme temperature events	High	Medium	Medium
Temperature	Solar radiation	Low	Low	Low
Wind	Gales and extreme wind events	High	Medium	Medium
Wind	Storms (snow, lightening, hail)	High	Medium	Medium
Soils	Soil moisture	Medium	Medium	Medium
Soils	Runoff	Medium	Medium	Medium

Variable	Variable	Sensitivity	Exposure*	Vulnerability
Soils	Soil stability	High	Medium	Medium

*Exposure for the operation vulnerability assessment has been based on the 2080s to represent the worst case scenario.

11.16 Enhancement measures

11.16.1 Examples of enhancement measures may include:

- Use of vegetation to slow the movement of surface water;
- Use of drought resistant species for planting;
- Use of green infrastructure to bind soil;
- Reducing the area of impermeable surface; and
- Installation of solar or wind powered ancillary equipment.

11.17 Proposed assessment methodology

11.17.1 Section 11.15 identified climate variables that the scheme is likely to be vulnerable to. The risks for the scheme associated with these variables will be assessed further during the EIA, as follows. The significance of effects is determined by considering the consequence and the likelihood of potential impacts associated with changes in climate variables on scheme receptors occurring. Likelihood and consequence are qualitatively assessed using the descriptions in table 11.12 and Table 11-13.

11.17.2 The assessment of likelihood and consequence (and therefore significance) takes embedded mitigation into account. Embedded mitigation is identified through consultation with the project design team.

Table 11.12 – Consequence definitions

Measure of consequence	Description
Negligible	No infrastructure damage, minimal adverse effects on health, safety and the environment or financial loss. Little change to service and disruption lasting less than 1 day.
Minor adverse	Localised infrastructure disruption or loss of service. No permanent damage, minor restoration work required: disruption lasting less than 1 day. Small financial losses and/or slight adverse health or environmental effects.
Moderate adverse	Limited infrastructure damage and loss of service with damage recoverable by maintenance or minor repair. Disruption lasting more than 1 day but less than 1 week. Moderate financial losses. Adverse effects on health and/or the environment.
Large adverse	Extensive infrastructure damage and severe loss of service. Disruption lasting more than 1 week. Early renewal of infrastructure 50-90%. Permanent physical injuries and/or fatalities. Major financial loss. Significant effect on the environment, requiring remediation.
Very large adverse	Permanent damage and complete loss of service. Disruption lasting more than 1 week. Early renewal of infrastructure >90%. Severe health effects and/or fatalities. Extreme financial loss. Very significant loss to the environment requiring remediation and restoration.

Table 11.13 – Likelihood definitions

Measure of likelihood	Description
Very high	The event occurs multiple times during the lifetime of the scheme e.g. approximately annually.
High	The event occurs several times during the lifetime of the scheme e.g. approximately once every five years.
Medium	The event occurs limited times during the lifetime of the scheme e.g. approximately once every 15 years.

Measure of likelihood	Description
Low	The event occurs occasionally during the lifetime of the scheme e.g. once in 60 years.
Very low	The event may occur once during the lifetime of the scheme.

Significance criteria

11.17.3 The likelihood and consequence are combined to assess the significance of effects on receptors, as shown in Table 11.14. The assessment is qualitative and based on expert judgment based on knowledge of similar schemes, engagement with the wider WSP Design Team and a review of relevant literature.

Table 11.14 – Significance rating matrix

Likelihood	Consequence of hazard occurring 'Negligible'	Consequence of hazard occurring 'Minor Adverse'	Consequence of hazard occurring 'Moderate Adverse'	Consequence of hazard occurring 'Large Adverse'	Consequence of hazard occurring 'Very Large Adverse'
Very High	Not significant	Significant	Significant	Significant	Significant
High	Not significant	Significant	Significant	Significant	Significant
Medium	Not significant	Not significant	Significant	Significant	Significant
Low	Not significant	Not significant	Not significant	Significant	Significant
Very Low	Not significant	Not significant	Not significant	Significant	Significant

11.18 Assessment assumptions and limitations

11.18.1 To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- The UKCP18 projections have been used to infer future changes in a range of climate variables that may affect the vulnerability of the scheme to climate change. At the time of writing, these represent the

most up-to-date representation of future climate in the UK. However, the UKCP18 data currently available does not provide data for extreme precipitation, drought, snow and ice or wind.

- There are inherent uncertainties associated with climate projections and they are not predictions of the future. It is possible that future climate will differ from the future baseline climate against which the resilience of the scheme has been assessed, depending on global emissions over the next century. A 'high' emissions scenario (RCP 8.5) using the 2080s timeslice (2070 – 2099 - the longest temporal scale available through UKCP18) has been used to develop the baseline against which resilience has been assessed. This is consistent with the precautionary principle (i.e. 'worst case' scenario).
- Any further research, analysis or decision-making should take account of the accuracies and uncertainties associated with climate projections. It is also important to note that the analysis is based on selected observational data, the results of climate model ensembles and a selected range of existing climate change research and literature available at the time of assessment. Any future decision-making based on this analysis should consider the range of literature, evidence and research available at that time and any changes to this.

11.19 Factors and elements scoped in and out of further assessment

11.19.1 The factors to be scoped in for further assessment as identified in the vulnerability assessment (Table 11-10 and 11-11) are summarised in Table 11.15.

Table 11.15 – Climate elements scoped in and out of further assessment

Element	Phase	Scoped In	Scoped Out	Justification
Drought Extreme precipitation events Extreme temperature events Gales and extreme wind events Storms (snow, lightning, hail)	Construction	Yes	No	Assessed as medium vulnerability.
Sea level rise Storm surge and storm tide Change in annual average precipitation Change in annual average temperature Solar radiation Soil moisture Runoff Soil stability	Construction	No	Yes	Assessed as low vulnerability.

Element	Phase	Scoped In	Scoped Out	Justification
Sea level rise Storm surge and storm tide Change in annual average Drought Extreme precipitation events Change in annual average Extreme temperature events Gales and extreme wind events Storms (snow, lightning, hail) Soil moisture Runoff Soil stability	Operation	Yes	No	Assessed as medium or high vulnerability.
Solar radiation	Operation	No	Yes	Assessed as low vulnerability.

12 Population and health

12.1 Study area

12.1.1 DMRB Volume 11 Section 3, as updated by Interim Advice Note (IAN) 125/15, provides guidance on the assessment of some of the elements considered under Population and Health (i.e. Parts 6 (*Land Use*), 8 (*Pedestrians, Cyclists, Equestrians and Community Effects*), and 9 (*Vehicle Travellers*). DMRB, however, does not provide guidance on setting the study area. As such, the

study areas for each Population and Health element have been identified using professional judgement based on experience on similar road schemes.

12.1.2 The study areas for the various elements of the assessment of population and health effects are as follows:

- Effects on communities and community land: the study area for community severance is a 1km radius from the scheme to include communities that may potentially be directly impacted by the scheme. The study area for effects on private assets and demolition of private property, community land and development land 9 Following recent updates on DMRB guidance, effects on Agricultural Land are now considered as part of the assessment on Geology and Soils.) will be defined by the scheme footprint;
- Effects on pedestrians, cyclists and equestrians (i.e. Non-Motorised Users (NMUs)): the study area includes existing PRoW, pedestrian and cyclists and equestrian's routes within 1km of the scheme;
- Effects on population (other than those addressed above) and economy has been reported for the BCKLWN local authority area, in addition to the more localised area of the West Winch Ward; and
- Effects on health: Health baseline conditions has been reported for the BCKLWN local authority area. The study areas for effects associated with air quality, noise and water are described in chapters 3, 7 and 8 of this EIA Scoping Report respectively.

12.2 Consultation

Consultation undertaken to date

12.2.1 No specific consultation has been undertaken to date.

Proposed consultation

12.2.2 No consultation is proposed as part the EIA.

12.3 Baseline conditions

Baseline data collected to date

12.3.1 Data has been collated from various online sources including Google Maps, Bing Maps, MAGIC, Office of National Statistics Labour Market Statistics Report (NOMIS), Public Health Profiles and the English indices of deprivation.

12.3.2 The Hardwick Green Environmental Statement (Hardwick Green, North Runcton, King's Lynn, Updated Environmental Statement, Volume 1 Main Report, June 2016) has also been referred to due to its close proximity to the scheme.

Communities

12.3.3 The following community facilities have been identified within 1km of the scheme:

- Scout Hut and associated outdoor activity spaces, Chequers Lane, approximately 100m west of the scheme;
- Playing Field, approximately 380m west of the scheme;
- St Mary's Church, Main Road (A10) opposite Post Office, West Winch PE33 0NP, approximately 460m west of the scheme;
- West Winch Village Stores, 212 Main Road, West Winch, King's Lynn PE33 0NP, approximately 530m west of the scheme;
- West Winch Post Office, 216 Main Road, West Winch, King's Lynn PE33 0NP, approximately 550m west of the scheme;
- North Runcton Cricket Club, North Runcton, King's Lynn PE33 0RB, approximately 650m east of the scheme;
- West Winch Primary School, Back Lane, West Winch PE33 0LA, approximately 680m west of the scheme;
- William Burt Social Club, Watering Lane, West Winch, King's Lynn PE33 0JY, approximately 680m west of the scheme;

- Kings Lynn Caravan and Camping Park, Parkside House, New Road, North Runcton, King's Lynn PE33 0QR, approximately 690m east of the scheme;
- All Saints Church, Church Farm the Green, North Runcton, King's Lynn PE33 0RB, approximately 930m east of the scheme; and
- Buttercups Pre-school, The Village Meeting Place, The Green, North Runcton PE33 0RB, approximately 960m east of the scheme.

Community severance

12.3.4 The majority of community facilities are located in the centre of West Winch and North Runcton which are in close proximity to the A10 and New Road respectively. The A47, Rectory Lane and Chequers Lane also provide access for residential properties, so there is no noticeable community severance at present.

Community land

12.3.5 There are several areas of Conclusive Registered Common Land under the Countryside Rights of Way (CRoW) Act 2000 ("registered common land") within the study area, the closest being within the scheme boundary at Hardwick Interchange roundabout and the A47 layby to Sheeps Course Wood. Other common land areas include a section running from North Runcton to Setchey Common. The same registered common land areas are also Open Access land as designated under the CRoW Act 2000.

12.3.6 There is currently no Public Open Space which will be directly affected by the scheme. Furthermore, there is no National Trust land or allotments within the study area for communities and community land.

Development land

12.3.7 The scheme is within an area of land allocated for development as part of the West Winch Growth Area Strategic Policy. This land has been designated under the Kings Lynn & West Norfolk Borough Council Local Plan (King's Lynn & West Norfolk Borough Council, Site Allocations and Development

Management Policies Plan, Adopted September 2016) for development of up to 4,000 dwellings to the west of the scheme and east of West Winch village. As identified in Chapter 13 - Cumulative, there have been two planning applications submitted for residential developments within this area; Land at West Winch and Land West of Constitution Hill which will provide 500 and 1,110 new dwellings respectively; the former has been temporarily withdrawn pending resubmission, and the latter is currently awaiting determination.

Private property

12.3.8 At present, the dualling of the A47 will require the demolition of two residential properties located on the northern side of the existing A47 alignment. This will be confirmed as the design progresses and will be considered within the ES.

Non-motorised users

12.3.9 There are four PRoWs in close proximity to the scheme; West Winch FP3, North Runcton FP1, North Runcton RB3 and North Runcton BR4. There are several other PRoWs located further from the scheme, as discussed in Chapter 6 - Landscape and Visual. There are no National Trails, designated Recreational Routes or National Cycle Network routes within 1km of the scheme. The closest designated Recreational Route, the Nar Valley Way, is approximately 1.3km from the scheme and closest National Cycle Network, the northbound Sustrans Local Cycle Route, is approximately 1.9km from the scheme.

Population and economy

12.3.10 The West Winch Ward Local Area Report 2011 and Labour Market Profile – King's Lynn and West Norfolk 2019 (Labour Market Profile – King's Lynn And West Norfolk, 2019) available from NOMIS, a service provided by the Office for National Statistics (ONS), provides detail on the local population and economy.

12.3.11 The total resident population of West Winch was 4,734 at the time of the Census 2011, 48.7% being male and 51.3% being female. 42.9% of the

population were deemed as having very good health and 1% as having very bad health.

12.3.12 71.4% of the population were aged between 16 and 74. Of this part of the population: 62% were in employment (including 50.4% employed and 11.7% self-employed) and 2.6% were unemployed. The most prevalent industries in which the population was employed were wholesale and retail trade, repair of motor vehicles and motor cycles (16%), human health and social work activities (14.8%) and manufacturing (13.4%). Furthermore, of the part of the population aged between 16 and 74, 2.7% were deemed long-term sick or disabled.

12.3.13 West Winch is located within BCKLWN. As stated in the Labour Market Profile – King's Lynn and West Norfolk 2019, the total population of King's Lynn and West Norfolk was 151,900 in 2017. 57.2% of the population were aged between 16 - 64 ("economically active") in 2017 (this was lower than the average for Great Britain at 62.9%). Of the economically active population of King's Lynn and West Norfolk in 2017, 74.9% were in employment (average for Great Britain was 75.1%) and 3.7% were unemployed (model-based) (average for Great Britain was 4.2%).

12.3.14 The qualifications profile of the economically active population of King's Lynn and West Norfolk and Great Britain in 2017 is shown in Table 12-1 overpage. The proportion of the population with a NVQ1-NVQ4 qualification was lower than the average for Great Britain. However, the proportion of the population with other qualifications (such as foreign qualifications and some professional qualifications) was higher than the average for Great Britain.

Table 12.1 – Comparison of economically active population between the local area and the national average

Qualification	King's Lynn and West Norfolk (%)	Great Britain (%)
NVQ4 And Above	27.7	38.6
NVQ3 And Above	56.3	57.2

Qualification	King's Lynn and West Norfolk (%)	Great Britain (%)
NVQ2 And Above	71.8	74.7
NVQ1 And Above	85.3	85.4
Other Qualifications	8.5	6.9
No Qualifications	6.1	7.7

Source: ONS annual population survey 2017

12.3.15 The earnings profile of the economically active population of King's Lynn and West Norfolk and Great Britain in 2018 is shown in Table 12.2, below. The gross weekly pay for all full-time workers was lower than the average for Great Britain. The gross weekly pay of male and female full-time workers was respectively £24.30 and £87.60 less than the average for Great Britain.

Table 12.2 – Comparison of gross weekly pay between the local area and the national average

Gross Weekly Pay	King's Lynn and West Norfolk (£)	Great Britain (£)
Full-Time Workers	517.6	571.1
Male Full-Time Workers	587.9	612.2
Female Full-Time Workers	422.4	510.0

Source: ONS annual survey of hours and earnings 2018

Health

12.3.16 The Health Profile 2018 for King's Lynn and West Norfolk summarises that "the health of people in King's Lynn and West Norfolk is varied compared with the England average. About 15% (3,900) of children live-in low-income families. Life expectancy for both men and women is similar to the England average" (King's Lynn and West Norfolk Local Authority Health Profile, 2018).

12.3.17 It states that King's Lynn and West Norfolk scored 23.4 for deprivation compared to 21.8 for England (the England worse score being 42 and England best being 5) as per the Index of Multiple Deprivation 2015.

12.3.18 There were eight indicators for which King's Lynn and West Norfolk scored significantly worse than England in, including people "killed and seriously injured on roads" (2014-2016).

12.3.19 Baseline conditions with regards to air quality, noise and vibration and the water environment are described in Chapters 3, 7 and 8 of this EIA Scoping Report respectively.

Proposed baseline data collection

12.3.20 No further data collection is proposed.

12.4 Mitigation measures

12.4.1 Mitigation measures incorporated within the highway design, along with mitigation recommended for other environmental topics (e.g. air quality, landscape, noise and vibration and the water environment) to be implemented during construction and operation will, in turn, reduce adverse effects on population and health. Mitigation measures associated with the design and with the other environmental issues will be reviewed. Should additional mitigation measures be identified as required for any of the population and health issues to be assessed, these will be reported in the ES.

12.5 Description of likely significant effects

Effects on communities and community land

12.5.1 Most of the community facilities are located far from the scheme, with the closest facility being a playing field approximately 380m west of the scheme alignment. Therefore, significant adverse effects on community facilities are not anticipated.

12.5.2 The residential population will not experience severance from community facilities as a result of the scheme. The section of the A47 serving residential

properties in the vicinity of North Runcton will be unaltered during construction, in addition to New Road and other minor roads. The A10 will be available for residents in West Winch to access community facilities in the village. Once the scheme is in operation, access to community facilities will be improved due to increased capacity on the highway network.

12.5.3 There are some sections of registered common land and open access land which are either within or adjacent to the scheme boundary. Potential effects, which are not anticipated to be significant, will be considered and reported in the ES.

Effects on development land

12.5.4 There is development land adjacent to the scheme which is planned to provide for up to 4,000 new homes. The scheme will help facilitate access to these residential developments. Therefore, the impact on development land may be significantly beneficial.

Effects on private property

12.5.5 Demolition of two residential properties north of the A47 is proposed. Therefore, the impact on private property may be significantly adverse. Mitigation measures will be developed and discussed in the ES.

Effects on non-motorised users

12.5.6 Potential effects on non-motorised users associated with the construction and operational phases of the scheme include impacts (either temporary or permanent) on existing facilities used for walking and cycling. These impacts could be in the form of temporary or permanent diversions, changes to the travel times of local NMUs, or changes to the safety or amenity of the NMUs routes.

12.5.7 West Winch FP3, North Runcton FP1, North Runcton RB3 and North Runcton BR4 PRoWs in close proximity to the scheme may be disturbed during construction. It is anticipated that the implementation of suitable mitigation measures, such as the provision of alternative routes and clear signage, will result in this not being a significant effect.

12.5.8 With regards to the operational phase, the scheme will include a new vehicular overbridge running over Rectory Lane with a shared footway and cycleway to encourage walking and cycling between North Runcton and West Winch. Chequers Lane will be permanently stopped up for vehicular traffic and a new NMU overbridge provided to maintain access for pedestrians and cyclists over the scheme. These features are likely to result in beneficial effects on NMUs, which are not expected to be significant effects.

12.5.9 The ES chapter will provide an assessment of the NMU proposals being incorporated as part of the design and will identify any additional mitigation measures that might be required. The assessment will be informed by the Transport Assessment (and associated work) which will be prepared to support the planning application.

Effects on population and economy

12.5.10 There is potential for the scheme to benefit the local economy in the short-term through creation of employment opportunities in the construction industry for the local population. Furthermore, if the import of specialist contractors occurs, this may increase spending in the local economy during the construction phase. During operation, the scheme and A47 dualling will offer improved accessibility to services and opportunities including schools and places of employment, but, which is not expected to be a significant effect.

Effects on health

12.5.11 The generation of noise and vibration, dust and exhaust emissions from construction vehicles and plant and minor modifications to traffic patterns (changing the distribution of airborne pollutants such as NO_2, NO_x, PM_{10} and $PM_{2.5}$) has a potential to adversely affect the health of the local population. Chapter 3 - Air Quality and Chapter 7 – Noise and Vibration provide further information on the potential health effects resulting from the scheme and propose “best practice” mitigation measures.

12.5.12 A reduction in driver stress levels during operation of the scheme is expected. Expansion of the existing road network once the scheme is in operation will alleviate congestion, in particular on the A10 and Hardwick Interchange, which is likely to improve current air quality and noise pollution experienced by residents.

12.5.13 It is anticipated that the effects on health caused by construction and operation of the scheme will not be significant. Once further design and construction details are available, the health effects for residents and NMUs can be assessed fully and will be included within the ES.

12.6 Enhancement measures

12.6.1 Enhancement measures for air quality, landscape and visual, noise and vibration and the water environment are discussed in Chapters 3, 6, 7 and 8 of this combined EIA Scoping Report respectively.

12.7 Proposed assessment methodology

12.7.1 The proposed methodology for the assessment of likely impacts on population and health during construction and operation of the scheme, and identification of the potential for significant effects, will be undertaken in accordance with the DMRB Volume 11, Section 3, Part 6 LA112 Population and Human Health. This supersedes the following previous guidance used to assess potential effects on population and health:

- Volume 11, Section 3, Part 6 (Land Use) August 2001;
- Volume 11, Section 3, Part 8 (Pedestrians, Cyclists, Equestrians and Community Effects) June 1993; and
- Volume 11, Section 3, Part 9 (Vehicle Travellers) June 1993.

12.7.2 The assessment will be split into two parts: Land Use and Accessibility and Human Health. DMRB Volume 11, Section 2, Part 4 LA104 Environmental Assessment and Monitoring guidance will be used to determine the level of significance for likely impacts for the Land Use and Accessibility aspect.

12.7.3 The elements and study areas of the Land Use and Accessibility and Human Health assessments are set out as follows:

Land use and accessibility

- **Private property and housing (previously referred to as private property and development land):**
  - Land parcels of private properties, land owned by private landowners and housing allocations that lie within 500m of the scheme boundary, or those which have a direct means of access within the site; and
  - The assessment will identify disruption to access, likely severance and the extent and level of housing land lost as a result of the scheme. The location and likely effects on residential development land will also be assessed.
- **Community land and assets (previously referred to as communities and community land):**
  - Community land, community and recreational facilities located within 500m of the scheme boundary, or those which have a direct means of access within the site; and
  - The assessment will identify the location and level of use of community land and assets. The impacts on the public will be set out in terms of accessibility restrictions / severance and changes to amenity.
- **Development land and businesses (new element):**
  - Land parcels of businesses and employment land allocations located within 500m of the scheme boundary, or those which have a direct means of access within the site; and
  - The assessment will identify the disruption to access, likely severance and the extent of commercial land lost as a result of the

scheme. The location and likely effects on commercial development land will also be assessed.

- **Agricultural land holding (scoped out):**
  - BCKLWN and their legal advisors are currently undertaking liaison with those who own/lease agricultural land holdings within the scheme boundary thus any further assessment is scoped out of the EIA process.
- **Walkers, Cyclists and Horse Riders (WCH) (previously referred to as non-motorised users):**
  - PRoW and non-designated routes located within 500m of the scheme boundary; and
  - The assessment will identify likely routes taken by WCHs. If the information is available, the frequency of use for these routes will be determined in consultation with NCC. The assessment will set out the impact on WCH receptors according to change in journey length.

12.7.4 Please note that the previously included Vehicle Travellers element is no longer part of the population and health assessment, and the Population and Economy element is now covered by the accessibility to employment facilities section of the Human Health assessment (discussed below) in line with DMRB LA112 guidance.

Human health

12.7.5 A qualitative assessment will be undertaken to determine effects of the scheme on human health. Changes to health determinants as a result of the scheme will be identified using appropriate information from ES topics and any other available information regarding health;

- Health determinants likely to be affected by the scheme, and therefore, included in the assessment of human health include; air quality; noise;

visual amenity; accessibility to community, healthcare, social and employment facilities and opportunities for physical activity;

- The sensitivity of the population will be determined using professional judgement applied to the health profile presented in the baseline, and reported as negligible, low, medium, or high; and
- A health receptors' sensitivity is based on their ability to experience a potential impact without incurring a substantial change to their health status. Several elements will be used to determine receptor value including level of deprivation and accessibility.

12.7.6 There is currently no defined study area for human health within industry guidance. If guidance is developed to include a defined study area at the time of writing the ES, then that will be followed. If not, then the study area surrounding the scheme boundary for other environmental topics relevant to human health will be followed, and justification for each will be provided in the relevant topic chapters.

Significance criteria

- For Land Use and Accessibility, sensitivity criteria and magnitude of impact will be assigned according to Table 3.11 and Table 3.12 in the DMRB, Part 6, LA112 guidance;
- For Land Use and Accessibility, level of significance will be assigned according to Table 3.8.1 in the DMRB, Part 4, LA104 guidance;
- Significant effects for Land Use and Accessibility, comprise effects which are assigned as moderate, large or very large. The remaining effects will be categorised as non-significant; and
- In terms of Human Health, outcomes will be determined in accordance with Table 3.32 in the DMRB Part 6 LA112 guidance.

Assessment scenarios

- Land Use and Accessibility effects will be assessed during construction and for year 1 of the scheme in operation (future year);
- Human Health effects will be assessed during construction and up to year 15 of the scheme in operation (future year); and
- Mitigation measures and any environmental enhancements will be identified.

12.8 Assessment assumptions and limitations

12.8.1 The main limitation is the use of online mapping and data sources available at the time of the assessment. It is not considered, however, that these datasets have affected, or will affect, the robustness or quality of the assessment.

12.8.2 For the ES, the assessment will use qualitative descriptions. Quantitative evidence to support findings will be provided wherever possible.

12.9 Factors and elements scoped in and out of further assessment

12.9.1 The factors to be scoped in for further assessment as identified are summarised in Table 12.3.

Table 12.3 – Population and health elements scoped in and out of further assessment

Element	Element	Phase	Scoped In	Scoped Out	Justification
Land Use and Accessibility	Private property and housing	Construction and Operation	Yes	No	Required to ensure all aspects of the new DMRB LA112 guidance are assessed sufficiently, and the potential for significant effects is identified.
Land Use and Accessibility	Community land and assets	Construction and Operation	Yes	No	As above.
Land Use and Accessibility	Development land	Construction and Operation	Yes	No	As above.
Land Use and Accessibility	WCH	Construction and Operation	Yes	No	As above.
Land Use and Accessibility	Agricultural land holdings	Construction and Operation	No	Yes	BCKLWN and their legal advisors are currently undertaking liaison with those who own/lease agricultural land holdings within the scheme boundary thus any further assessment is scoped out of the EIA process.

Element	Element	Phase	Scoped In	Scoped Out	Justification
Human Health	Human Health	Construction and Operation	Yes	No	Required to ensure all aspects of the new DMRB LA112 guidance are assessed sufficiently, and the potential for significant effects is identified.

13 Assessment of cumulative effects

13.1 Introduction

13.1.1 This chapter sets out the proposed approach to the assessment of the potential for significant cumulative environmental effects as a result of the scheme. To accord with the EIA Regulations 2017 and best practice guidance, the following types of cumulative effects will be considered within the ES:

- Cumulative effects from different projects – The combined effects from different projects on a receptor; and
- Combined effects – The interaction and combination of environmental effects of the scheme affecting a receptor.

13.2 Proposed assessment methodology

13.2.1 The combined and cumulative assessment will follow DMRB LA 104 – Environmental Assessment and Monitoring guidance and consider the nature of the affected receptor and the impact concerned.

13.2.2 The assessment will cover the most likely significant combined and cumulative effects, rather than reporting every potential interaction. The criteria outlined in Section 3 of above DMRB guidance, used to derive the

significance of environmental effects, will be used alongside professional judgement to determine the significance of combined and cumulative effects.

Cumulative effects

13.2.3 The assessment of cumulative effects will be undertaken in accordance with the requirements of the EIA Regulations 2017 and adopting the methodology outlined below.

Step 1 – Identification and evaluation of projects for consideration

13.2.4 A high-level review of planning applications submitted to BKKLWN in the last 6 years will be undertaken in order to identify potential projects that could give rise to in-combination interaction with the scheme.

13.2.5 In setting the study area for the cumulative effects assessment, consideration will be given to schemes that:

- Have a concurrent demolition, construction or operational phases with the scheme;
- Are 'in proximity' to the scheme; or
- Are considered likely to result in environmental effects which could act in synergy with effects arising from the scheme.

13.2.6 Applicable projects for consideration of cumulative effects will be determined using the following criterion:

- Projects that are under construction;
- Permitted application(s) not yet implemented;
- Submitted application(s) not yet determined but have the potential to be determined prior to the determination of the scheme; and
- All refusals subject to appeal procedures not yet determined.

13.2.7 An initial review of planning applications which follow the above criteria based on a recent search of the BCKLWN online planning portal and through previous liaison with the Principal Planner and Scientific Officer at BCKLWN

has identified the following list of developments in Table 13.1. This list will be updated as the EIA progresses.

Table 13.1 – Developments in the surrounding area likely to be considered within the ES based on their current status (February 2020)

Reference Number	Description	Address	Approximate distance from scheme	Received	Status
18/02289/OM	Outline Application: Up to 500 homes with a neighbourhood centre, associated landscaping, parking and supporting infrastructure.	Land at West Winch	140m	Dec 2018	Application removed from Planning Portal (understood that will be re-instated once ES for proposed the development has been submitted)
13/01615/OM	Outline Application: development of up to 1,110 residential units (Class C3); primary school (Class D1); local centre (Class A1, B1, D1, D2); public open space, landscaping and highway access onto A47 and A10.	Land West of Constitution Hill Constitution Hill North Runcton Norfolk PE33 0QP	Immediately over northern section of scheme	Nov 2013	Awaiting decision
16/02231/OM	Residential development of the land to provide up to 600 dwellings, incorporating affordable housing, together with a local centre for uses A1, A2, A3 and/or A5 (600m2), D2 community floorspace (up to 500m2), open space, formal sport pitches, a car park to serve Reffley Wood and associated development.	Land West of Knights Hill Village Grimston Road South Wootton Norfolk	4.5km	Dec 2016	Appeal allowed
18/01750/RMM	Reserved Matters (NORA phase 4): Development for 94 dwellings	The Nar Ouse Regeneration Area (NORA), Wisbech Road, King's Lynn, Norfolk	1.9km	Oct 2018	Application permitted

Reference Number	Description	Address	Approximate distance from scheme	Received	Status
17/01151/OM	Outline Major Application: Sustainable mixed-use urban extension comprising up to 450 dwellings, a mixed-use local centre comprising Class A uses (including retail facilities and public house) and Class D1 (community) and B1 uses, open space and landscaping, wildlife area, children's play areas, sustainable urban drainage infrastructure, access and link road and associated.	Land NW of South Wootton School Off Edward Benefer Way King's Lynn, Norfolk	4.7km	June 2017	Application permitted
17/01106/OM	Outline Application Some Matters Reserved: Residential development for up to 125 dwellings together with associated works.	Land on the West Side of Nursery Lane South Wootton, Norfolk	5.4km	June 2017	Application permitted
15/01782/OM	Outline application with all matters reserved (for no more than 60 houses) proposed residential development with access off Grimston Road. Land accessed between 144 and 150 Grimston Road South Wootton	Land Accessed Between 142 And 150 Grimston Road, South Wootton, Norfolk	5.4km	Nov 2015	Application permitted
20/00724/FM	379 new homes and associated green space, landscaping and infrastructure, together with a new vehicular bridge over the sand line, including new roads, infrastructure and hard and soft landscaping	Land SE of Queen Mary Road N of Railway Line And S of Parkway Gaywood King's Lynn Norfolk	1.2km	May 2020	Awaiting decision

13.2.8 Publicly available environmental information in planning portals on the above planned developments will be used as the basis of the assessment of cumulative effects.

13.2.9 The cumulative impact assessment will consider those parts of the West Winch Growth Area for which information is readily available (on the BCKLWN Planning Portal), alongside a high level assessment of predicted cumulative effects for the remainder of the circa 4000 residential units.

13.2.10 Following this, application results will be evaluated to inform the selection of developments for consideration. The selection criteria are:

- Application status and programme for delivery;
- Applications of a relevant scale – applications for residual development of 10 or more homes; industrial, commercial or retail based applications over 500m²; and
- Common sensitive receptors – only those applications with identifiable common receptors.

13.2.11 Discussions are still ongoing with BCKLWN to determine if the King's Lynn Transport Strategy (KLTS) and A47 Alliance developments are to be included within the assessment. This is to be resolved and will be clarified within the ES.

13.2.12 Available supporting application documentation will be reviewed in order to complete the selection criteria.

Step 2 – Identification of common receptors

13.2.13 Common receptors will be evaluated in terms of their broad receptor category in accordance with Regulation 4(2) of the EIA Regulations 2017. The specific receptors will then be identified and evaluated; ensuring that cumulative effects are considered at the receptor level and a more detailed level of assessment is only undertaken where there is a common receptor and likely significant effect.

Step 3 – Assessment of cumulative effects

13.2.14 Once the receptors for assessment have been defined, consideration will be given to their tolerance to the cumulative effects from the developments identified in Step 1 above.

13.2.15 In order for there to be a potential cumulative effect, there needs to be a potential effect from scheme in combination with the developments identified on the same receptor for a similar duration within the overall programme. Where topic elements have been scoped out from further consideration in the preceding topic chapters as they are not considered likely to give rise to significant effects during construction and/or operation, then (subject to agreement via the Scoping Opinion) these would not be considered further during the cumulative effects assessment.

13.2.16 The qualitative evaluation at the receptor level will consider the following:

- Combined magnitude of impact;
- Sensitivity/ value/ importance of the receptor/ receiving environment to change; or/and
- Duration and reversibility of effect.

13.2.17 Through a combination of the qualitative evaluation and mitigation presented in the ES, conclusions will be drawn as the likelihood for significant cumulative environmental effects resulting from the construction and operation of the scheme in combination with other developments.

Combined effects

13.2.18 The study area for the combined effects assessment will be set for each individual topic in line with DMRB.

13.2.19 Each topic chapter will assess the categories of receptors and/or specific named receptors relevant to that topic's methodology. In some instances, the same receptor or resource may be assessed in more than one

topic chapter. In these cases, there is the possibility that several individual effects on the same receptor may add up to create a significant cumulative effect. Thus, when considering the combined effects on a given receptor, several topic chapters will be reviewed.

13.2.20 The assessment of effect interactions will be approached from the perspective of changes in baseline conditions at specific sensitive receptors based on information in the topic chapters of the ES. A matrix of effect interactions will be formulated for the scheme, corresponding to the construction and operational phases.

Combined effects during construction

13.2.21 The construction of the scheme could potentially have the following effects:

- Increased dust, noise and vibration;
- Visual intrusion;
- Adverse effects on surface water, groundwater and flood risk; and
- Loss and severance of priority habitats.

13.2.22 Receptors most at risk from combined effects during scheme construction are those in proximity to construction activities. The severity of effects would be dependent upon:

- The type of works being undertaken;
- The duration of the works;
- The distance between the works and their respective proximity to the receptor;
- The sensitivity of the receptor; and
- The visible presence of the works.

13.2.23 Temporary land-take required for ancillary works such as compounds, diversions or working space and material storage would also have the potential to cause environmental effects.

Combined effects during operation

13.2.24 The operation of the scheme could potentially have the following effects:

- Changes to noise and vibration;
- Adverse effects on surface water, groundwater and flood risk;
- Reduction in traffic congestion on the existing road network and provision of a more consistent traffic speed;
- Improved accessibility to services and opportunities leading to beneficial effects on the population and economy;
- Adverse effects on the setting and quality of the local landscape; and
- Reduction in visual amenity for residents and highway and PRoW users.

13.2.25 Receptors closest to the road are likely to be exposed to more combined effects; possibly experiencing a combination of reduced visual amenity, light and noise pollution and improved accessibility as a result of the scheme.

13.2.26 The common sensitive receptors will be identified and will be outlined alongside their residual effect per technical discipline. This will enable a qualitative assessment of the overall significance of the cumulative effects on the common sensitive receptors identified using professional judgement and the technical information provided in the ES and supporting appendices.

13.2.27 The combined effects will be presented in a spreadsheet of impacts for each receptor which has more than one impact.

13.3 Limitations and assumptions

13.3.1 The assessment of effect interactions resulting from the scheme will be focused on the residual effects from the construction and operational phases following the implementation of mitigation measures as identified within each of the ES technical chapters. It will be assumed that identified mitigation measures would be incorporated or adopted to mitigate any negative effects resulting from the scheme.

13.3.2 The assessment of cumulative effects with other developments will be based on the interpretation and assessment of data provided by third parties.

14 Major accidents and disasters

14.1 Introduction

14.1.1 Major accidents or disasters are events or situations that have the potential to affect a development causing immediate or delayed serious damage to one or more of the following: human health, welfare, and the environment. This chapter considers the risks of major accidents and disasters (hereafter referred to as major events) during construction and operation of the scheme caused by natural or manmade hazards.

14.1.2 The starting list of potential major event categories and types to which a development could potentially be vulnerable, dependent upon the development type and its geographic location, are listed in Table 14.1.

Table 14.1 – Major event categories and types

Category	Type	Examples Considered
Natural	Geophysical	Earthquakes Volcanic Activity Landslides Sinkholes Tsunamis
Natural	Hydrological	Coastal Flooding Fluvial Flooding Pluvial Flooding Groundwater Flooding Avalanches
Natural	Climatological and metrological	Cyclones, hurricanes, typhoons, storms and gales Thunderstorms Wave surges Extreme temperatures: Heatwaves, Low (sub-zero) temperatures and heavy snow Droughts Fog Wildfires Poor Air Quality
Natural	Space	Solar Energetic Particles Solar Flares Coronal Mass Ejections
Natural	Biological	Disease epidemics: Viral, Bacterial, Parasitic, Fungal, Animal Diseases: Invasive Plants

Category	Type	Examples Considered
Technological or manmade hazards	Societal	Public demonstrations Widespread damage to societies and economies. The need for large-scale multi-faceted humanitarian assistance. The hindrance or prevention of humanitarian assistance by political and military constraints. Significant security risks for humanitarian relief workers in some areas. Famine Displaced population
Technological or manmade hazards	Industrial and urban accidents	Major Accident Hazard Chemical sites Major Accident Hazard Pipelines Nuclear Fuel storage Dam breaches Mines and storage caverns Fires
Technological or manmade hazards	Transport accidents	Road Rail Waterways Aviation
Technological or manmade hazards	Pollution accidents	Air Land Water
Technological or manmade hazards	Utility failures	Electricity Gas Water supply Sewage system

Category	Type	Examples Considered
Technological or manmade hazards	Malicious attacks	Unexploded Ordnance Attacks: Chemical, Biological, Radiological, Nuclear Transport systems Crowded places Cyber Infrastructure
Technological or manmade hazards	Engineering accidents and failures	Bridge failure Flood defence failure Mast and tower collapse Property or bridge demolition accidents Tunnel failure/fire

14.2 Study area

14.2.1 The study area for major events has been developed based on professional judgement as there is no specific regulatory guidance nor significant precedent or standardised methodology. The following factors and associated distances were adopted for setting the study area in order to capture internal and external influencing factors which may have high adverse consequences on the scheme:

- Manmade features:
  - Airports and airfields within 13km;
  - Control of Major Accident Hazard facilities within 3km;
  - Major accident hazard pipelines within 1km;
  - Fuel retail sites (including Liquified Natural Gas, Liquified Petroleum Gas) within 1km;
  - Rail infrastructure within 500m; and
  - Transmission (gas, electrical, oil/fuels) crossing the scheme boundary.
- Natural features with the potential to create risks within:
  - 3km (chiefly hydrological and geological, for example dam failure and seismic activity respectively); and
  - 1km (chiefly hydrological and geological, for example flood risk and unstable ground conditions respectively).

14.3 Baseline

14.3.1 The baseline conditions described for major events are derived from the following desk study sources:

- National Risk Register of Civil Emergencies (HM Government, 2020);

- British Geological Survey 'Onshore GeoIndex' (British Geological Survey, 2020);
- Tsunamis Hazard Map (PreventionWeb, 2005);
- The International Disaster Database (Centre for Research on the Epidemiology of Disasters, 2009);
- Health and Safety Executive's Planning Advice Web App (Health and Safety Executive, 2021);
- Health and Safety Executive's COMAH 2015 Public Information Search (Health and Safety Executive, 2015);
- Google aerial and street view maps covering Study Area (Google, 2021); and
- Technical chapters 3 to 12.

14.4 Key major events receptors

14.4.1 The environmental receptors of the scheme are described in detail in the technical chapters 2 to 12 and are not repeated here. This section identifies a set of selected key major event receptors. Specifically, those receptors that may be directly affected by the occurrence of a major event. The key major event receptors identified in the baseline within the Study Area are listed in table 14.2 below.

Table 14.2 – Identified key receptors for major events

Major Event Receptor	Type	Description
National Grid high pressure natural gas pipeline (Feeder 2).	Cross country pipeline within the scope of the Pipelines Safety Regulations 1996.	Runs across the scheme boundary.

Major Event Receptor	Type	Description
National Grid high pressure natural gas pipeline (Feeder 4).	Cross country pipeline within the scope of the Pipelines Safety Regulations 1996.	Runs across the scheme boundary.

14.5 Potential major events

14.5.1 The major events considered during the construction and operational phases of the scheme are documented in Appendix G. For potential major events that have been screened out, justification has been provided to support this decision.

14.6 Mitigation

14.6.1 Standard (tertiary) mitigation in each of the technical chapters 3 to 12 has been assumed will be implemented for the scheme in order to assess the magnitude of impact for each option; these are reported and discussed in detail in the relevant technical chapters.

14.7 Assessment of potential major events

14.7.1 Typical methods employed within an EIA to define significance are not applicable to the description of major events. In the context of this chapter, major events are events which rarely occur due to the mitigation, management or regulatory controls implemented to prevent them. By definition, if a major event were to occur the likely worst case would always be a major adverse effect.

14.7.2 For major events considered in Appendix G, the assessment concluded there is no likely requirement for further mitigation measures based on the design information currently available and on the further mitigation proposals described in the technical chapters 3 to 12 of this report.

14.7.3 The risks from major events are anticipated to be as low as reasonably practicable and no further consideration of Major Accidents and Disasters is therefore required within the ongoing EIA.

14.8 References

HM Government (2020) National Risk Register. Available at: National Risk Register 2020 (Accessed 26 January 2021)

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Health and Safety Executive (2021) COMAH 2015 Public Information Search. Available at: Health and Safety Executive (2021) COMAH 2015 Public Information (Accessed 26 January 2021)

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15 Summary

15.1 Proposed content and structure of the ES

15.1.1 The technical topics and factor-specific elements scoped in and out of further assessment as part of the ongoing EIA process are outlined in chapters 3 to 14 of this EIA Scoping Report.

15.1.2 The anticipated structure of the ES is set out below.

Volume 1 – Main Report

Front End

- Chapter 1: Introduction
- Chapter 2: The Existing Site
- Chapter 3: Description of the Proposed Scheme
- Chapter 4: Reasonable Alternatives Considered
- Chapter 5: Approach to EIA

Technical Chapters

- Chapter 6: Air Quality
- Chapter 7: Archaeology and Heritage
- Chapter 8: Biodiversity
- Chapter 9: Landscape and Visual
- Chapter 10: Noise and Vibration
- Chapter 11: Water Environment
- Chapter 12: Geology and Soils
- Chapter 13: Materials and Waste
- Chapter 14: Climate
- Chapter 15: Population and Health
- Chapter 16: Cumulative

Concluding Chapters

- Chapter 17: Conclusion and Summary of Environmental Effects

Volume 2 – Figures and Technical Appendices (including outline Construction Environmental Management Plan)

Volume 3 – Non-Technical Summary